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| April 2020 | |

[www.africa-rising.net](http://www.africa-rising.net)

Africa RISING West Africa Project

2019/2020 Workplan

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-in-development projects supported by the United States Agency for International Development as part of the U.S. government’s Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program’s monitoring, evaluation and impact assessment. <http://africa-rising.net/>

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**Contents**

[Summary 1](#_Toc38371116)

[Background 2](#_Toc38371117)

[Project logframe overview 5](#_Toc38371118)

[Ghana 8](#_Toc38371119)

[Partners and their responsibilities 8](#_Toc38371120)

[Planned work 10](#_Toc38371121)

[Consolidated budget 124](#_Toc38371122)

[Mali 127](#_Toc38371123)

[Partners and their responsibilities 127](#_Toc38371124)

[Planned work 129](#_Toc38371125)

[Consolidated budget 212](#_Toc38371126)

[Feed the Future and Custom Indicators 214](#_Toc38371127)

# Summary

The Africa RISING West Africa (WA) project is being implemented by multi-disciplinary research teams and development partners from the public and private sector in collaboration with farmers and community-based organizations in northern Ghana and southern Mali.

This document presents the work plans for the 2019-2020 research year for Ghana and Mali. The activities and sub-activities are mapped under the four Outcomes in the [Africa RISING West Africa Project Phase 2 logframe](#_Africa_RISING_West). Twenty-two (23) sub-activities are being implemented in the Ghana workplan, while sixteen (16) are being implemented in Mali. The distribution of the sub-activities per outcome is as presented in Table 1 below.

**Table 1:** Distribution of sub-activities per West Africa project logframe outcome

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Outcome 1** | **Outcome 2** | **Outcome 3** | **Outcome 4** |
| Ghana | 10 | 5 | 2 | 6 |
| Mali | 10 | 1 |  | 5 |

Linkages between activities, gender mainstreaming, capacity building and knowledge exchange and dissemination are embedded within all sub-activity plans. Publication of research results and better communication among research teams within and across countries will be a major focus.

# Background

Phase 1 (1 October 2012 - 30 September 2016) of the USAID-funded Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) project in West Africa (WA) was implemented in 25 intervention communities in northern Ghana and 9 villages in the Bougouni and Koutiala districts of the Sikasso Region in southern Mali under the *title 'Sustainable Intensification of Key Farming Systems in the Guinea-Sudano-Sahelian Zone of West Africa'*. Research activities under Phase 1 were organized around 3 research outputs (ROs), namely: 1) Situation analysis and program-wide synthesis (RO1); 2) Integrated Systems Improvement (RO2) and 3) Scaling and Delivery (RO3). Capacity building and gender were cross-cutting. Phase 2 (1 October 2016 - 30 September 2021) of the WA project was launched in February 2017.

Technological packages and/or practices validated in Phase 1 (see Table 2) are being scaled out targeting agro-ecosystems and socio-economic circumstances defined by the sustainable intensification (SI) domains - productive, economic, social, human and environmental. Linkages will be established with research and development partners to undertake both generic and back-stopping research. The generic research aims at completing the loose ends of research on the SI innovations in Phase 2 plus any other emerging issues. The back-stopping research will address researchable issues emerging from the scaling-out of SI innovations with the development partners.

Phase 2 is also exploring new research areas emerging from Phase 1 experiences and feedback by research and development partners, notably, using results from farming systems analyses and farm types to inform research targeting and technology dissemination; post-harvest management and value addition; nutrition-sensitive agriculture; labour-saving mechanization solutions for small-scale farmers; and climate-smart agriculture.

**Table 2:** List of validated technologies ready for promotion through development partners in Ghana and Mali

|  |  |  |
| --- | --- | --- |
| **Broad category** | **Validated flagship technology** | |
| **Ghana** | **Mali** |
| Introduction of new crops and varieties to overcome existing biotic and abiotic stresses and improve productivity per unit land area. | New varieties – drought-tolerant maize, rice, aflatoxin resistant groundnut, sorghum hybrids, early-maturing cowpea, dual-purpose cowpea, short-duration soybean, medium soybean, high yielding and disease-resistant varieties of improved vegetables (okra, roselle, tomato, eggplant and pepper) | High performing and dry season-adapted and farmer preferred vegetable varieties of okra (Konni), African eggplant (L10), Tomato variety (Rio Grande)  Aflatoxin resistant groundnut, early-maturing groundnut  Sorghum hybrids (Pablo, Fadda and Sewa), dual-purpose sorghum (Soubatimi, Tiandougou Coura, Jiguikala and Peke) |
| Agronomic practices to improve grain and fodder yield per unit land area and improve soil nitrogen. | Cereal-legume intercropping  Cereal-legume rotations  Dual-purpose food legumes  Cereal-vegetable intercropping  Cowpea living mulch (Maize cowpea intercrop for NRM and fodder support at household level  Optimal groundnut spacing  Maize leaf stripping for grain and fodder provision. | Cereal-vegetable intercropping (tomato, pepper)  Cereal-legume intercropping (groundnut)  Dual-purpose food legumes |
| Integrated soil fertility management as a cost-effective approach to replenish soil fertility. | Optimized N and P fertilizer rates  Fertilizer micro-dozing  Livestock corralling for manure/urine  Cereal-legume rotations  Cereal-legume intercropping | Fertilizer micro-dosing, composting  Cereal-vegetable intercropping (tomato, pepper)  Cereal-legume intercropping (groundnut) |
| Improved livestock feeds and feeding, housing, health and breeding management packages. | Sheep/goat flock feeding package  Sheep/goat health package  Housing and feeding for poultry  Guinea fowl hatching and brooding management  Stover quality improvement  Improved livestock feed troughs for small ruminants | Stover quality improvement using feed chopper |
| Introduction of pre- and post-harvest technologies to reduce food waste and improve food safety. | Storage – PICS bags, plastic drums  Aflasafe application  Maize shellers for postharvest support |  |
| The use of natural resources management as a means to preserve soil and water. | Soil and water conservation measures (e.g. contour bunding, ridge planting, cowpea living mulch) |  |
| Introduction of improved land and water management systems |  | Contour bunding associated with fast-growing tree species |
| Seed treatment |  | Apron Star 42WS |

# Project logframe overview

An overview of the Africa RISING West Africa Project logframe up to the activity level can be glanced from Table 3 below. All sub-activities initiated by project partners align with specific outcomes, outputs and activities within the logframe. Activities listed in italics within the table are those which have an ongoing sub-activity within this year’s (2019/2020) workplan in both Ghana and Mali. For a detailed look at other important logframe elements like objectively verifiable indicators, sources and means of verification, the assumptions for each output etc. the complete project logframe document is accessible at: <https://hdl.handle.net/10568/82851>.

**Table 3:** Logframe overview

|  |  |
| --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | |
| Output 1.1: Research products for more productive, intensive, diverse, profitable and resilient crop (cereals, legumes, and vegetables); livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners. | *Activity 1.1.1: Test and disseminate a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production.*  *Activity 1.1.2: Test and disseminate a combination of improved breeds, housing, feeding, health and breeding practices to intensify rearing of livestock (sheep, goat, pig, and poultry) for meat, egg and milk production.*  *Activity 1.1.3: Test and disseminate integrated crop-livestock-soil and agroforestry systems to increase and sustain productivity and reduce risk.* |
| Output 1.2: Integrated management practices and innovations to improve and sustain productivity and ecosystems services of the soil, land, water and vegetation resources are developed and disseminated with farmers and development partners in the intervention communities. | *Activity 1.2.1: Test and disseminate land, soil and integrated land-soil technologies and practices to improve and sustain productivity and ecosystems services at the farm and landscape/watershed levels.*  *Activity 1.2.2: Test and promote water management technologies and practices to increase water productivity in the small-scale crop-livestock farming systems under rain fed and irrigated conditions.*  Activity 1.2.3: Test and promote integrated soil fertility and integrated pest management technologies and practices to increase and sustain productivity and reduce risk. |
| Output 1.3: Labor-saving and gender-sensitive technologies in target areas to reduce drudgery while increasing labor efficiency in the production cycle delivered. | Activity 1.3.1: Train local partners on appropriate use of drudgery-reducing technology delivery.  Activity 1.3.2: Introduce, test and adapt existing pre-harvest small-scale mechanization options to farmers and partners in the intervention communities.  Activity 1.3.3: Demonstrate small-scale maize shelling machines to smallholders and other stakeholders to reduce drudgery and labor requirements |
| Output 1.4: Tools (including ICT-based) and approaches for disseminating recommendations in relation to above research products, integrated into capacity development (and used in outcomes 4 and 5). | Activity 1.4.1: Generate technology extrapolation domains in West Africa. |
| Outcome 2: More farmers and farm families are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | |
| Output 2.1: Improved technologies, innovations, practices and habits to increase production and consumption of safe diverse and more nutritious food for farm families, especially by women and children developed and disseminated in partnership with research and development partners. | Activity 2.1.1: Develop a nutrition strategy to harmonize the nutrition activities with national nutrition approaches and link them to the crop and livestock activities.  *Activity 2.1.2: Train farm families, especially women to produce and consume diverse and more nutritious food.*  Activity 2.1.3: Use nutrition focused activities as an entry point for greater involvement of younger women and the youth in the production and consumption of diverse and more nutritious foods. |
| Output 2.2: Postharvest technologies and practices to provide options for the food, and feed sectors are tested and disseminated to farmers, through researchers, extension staff, and development partners. | *Activity 2.2.1: Introduce, evaluate, adapt and disseminate existing postharvest technologies and practices.*  *Activity 2.2.2: Build capacity of farm families to reduce postharvest losses.* |
| Outcome 3: Farmers and other value chain actors have greater and equitable access to production assets and markets (input and output) through enabling institutions and policies. | |
| Output 3.1: Enabling policies and institutional arrangements to increase participation of farm families, especially women and youth in the output and input markets and decision-making are advocated for implementation by national governments, policy makers and development partners. | *Activity 3.1.1: Review existing policies and institutional arrangements affecting equitable access to production assets and markets.*  Activity 3.1.2: Assess the level of inclusiveness of women and the youth along crop and livestock value chains.  Activity 3.1.3: Advocate enabling policies and institutional arrangements to increase participation of farm families, especially women and youth in the output and input markets. |
| Output 3.2: Options to expand accessibility of production assets and increase participation in house-hold decision-making by disaggregated groups by gender. | *Activity 3.2.1: Identify constraints to, and opportunities for increasing women and youth access to production assets in the target area.* |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI, technologies, innovations and practices. | |
| Output 4.1: Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices to scale. | *Activity 4.1.1: Conduct cost-benefit and gender analysis coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts.*  *Activity 4.1.2: Map and assess relevant stakeholders to establish dialogue for the exploration of mutual synergies for scaling delivery of validated technologies.*  Activity 4.1.3: Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways. |
| Output 4.2: Gender-sensitive decision support tools to assess technology-associated risks and opportunities are available for use by project partners. | Activity 4.2.1: Identify and communicate gender-sensitive decision support tools in the context of different farm typologies. |
| Output 4.3: An updated framework for monitoring technology adoption to be used by the project team and scaling partners available and accessible | *Activity 4.3.1: Monitor and report technologies and their associated beneficiaries or farmers exposed to the innovations using the tools developed by IFPRI.*  Activity 4.3.2: Make these reports available on the Africa RISING repositories. |
| Output 4.4: Knowledge sharing centers (physical structures) and learning alliances are developed within existing local and regional institutions | *Activity 4.4.1: Establish knowledge-sharing and learning alliances among scaling actors.* |

# Ghana

## Partners and their responsibilities

|  |  |  |
| --- | --- | --- |
| **Name** | **Acronym** | **Role/responsibility** |
| **Government Ministries/Entities** | | |
| Ministry of Food and Agriculture | MoFA | Scaling-out SI technologies and establishment of R4D platforms |
| Ghana Health Services | GHS | Household nutrition R4D with UDS and IITA |
| Women in Agriculture Development | WIAD | Mobilization of community interest groups for nutritional messaging |
| Ghana Health Service | GHS | Assist with training of women’s groups on nutrition education, home visits, data collection and compilation of monthly reports on activities |
| Ghana Irrigation Development Authority | GIDA | Potential scaling partner for irrigation technologies with IWMI |
| **National Academic/Research Institutions** | | |
| Animal Research Institute | ARI | R4D on livestock production (sheep and goats) with ILRI |
| Kwame Nkrumah University of Science and Technology | KNUST | Graduate student training and R4D on soil-water dynamics |
| Science and Technology Policy Research Institute | STEPRI | Policy and institutional research |
| University for Development Studies, School of Health | UDS-SoH | R4D on livestock nutrition and human nutrition, Graduate student training |
| University for Development Studies, Faculty of Agriculture | UDS-FA | Assess the potential of local Napier fodder species and pigeon peas for improved soil health and ruminant productivity |
| Zentrum fuer Entwicklungsfoschung Bonn | ZEF | Studies of impact of SI technologies on household welfare, poverty, perceived shock, the environment, and food and nutrition security |
| Soil Research Institute | SRI | Technical backstopping soil research specifically on fertilizer trials with IITA |
| Savanna Agricultural Research Institute | SARI | Provide regional support on agricultural activities ranging from biophysical and social sciences |
| **International Academic/Research Institutions** | | |
| International Food Policy Research Institute | IFPRI | Lead site selection, baseline survey and monitoring and evaluation |
| International Institute of Tropical Agriculture | IITA | Overall project coordination and R4D research on cereal-legumes |
| International Livestock Research Institute | ILRI | Lead R4D on ruminants in Ghana and natural resources governance in Mali |
| International Water Management Institute | IWMI | Lead R4D on water management |
| Wageningen University and Research, The Netherlands | WUR | R4D on farming systems characterization and graduate training |
| **Private Partners** | | |
| ESOKO | ESOKO | Digital Service Provision to Farmers |
| WorldCover | WorldCover | Index-based crop Insurance for profit company to some of Africa RISING farmers |

## Planned work

The planned activities are presented in the protocols. Activities under each protocol are aimed at achieving the outputs under the four outcomes in the project logframe (see Table 3).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | |
| a. Output 1.1 | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | | |
| b. Activity 1.1.1 | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | | | | |
| c. Sub-activity GH1111-19 | | | Evaluating the effect of cowpea living mulch on weed control, soil properties and maize yield. | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | |
| Name | | | | | Institution | | | | Role | | | | |
| Abdul Rahman Nurudeen | | | | | IITA | | | | Cereal agronomy and plant nutrition | | | | |
| Bekele Kotu | | | | | IITA | | | | Economic analysis | | | | |
| Gundula Fischer | | | | | IITA | | | | Gender studies | | | | |
| Francis Muthoni | | | | | IITA | | | | GIS input | | | | |
| Fred Kizito | | | | | IITA | | | | Land and water management | | | | |
| Wilson Agyei Agyare | | | | | KNUST | | | | Soil and water management | | | | |
| Bosiako Ohene Antwi | | | | | KNUST | | | | Soil and water management | | | | |
| Benedict Boyubie | | | | | IITA | | | | FtF indicators and ensure data upload on Dataverse | | | | |
|  | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | |
| Name | | | | Institute | | | Degree | | | Start | | | End |
| Albert Berdjour | | | | UDS | | | MPhil | | | 2016 | | | 2019 |
|  | | | | | | | | | | | | | |
| f. Location(s) | Northern (Tingoli, Cheyohi no. 2, Doku, Tibali), Upper East (Samboligo, Nyangua, Gia, Bonia), Upper West (Zanko, Guo, Goli, Goriyiri) regions | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| g. Start | June 2017 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| h. End | December 2021 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | |
| Maize (Zea mays L.) is a major cereal crop in West Africa, accounting for slightly over 20% of the gross domestic production in the sub-region ([[1]](#footnote-1)Manyong *et al*., 2000). Grain yields on farmers’ fields are low due to several biophysical and socio-economic factors, including low and erratic rainfall, low soil fertility, and weed infestation. Living mulch of legumes conserves nitrogen in grain crops, reduce soil erosion and weed pressure, and increase soil organic matter ([[2]](#footnote-2)Hartwig and Ammon, 2002). This study was planned to start during the 2017 research year to test the hypothesis that cowpea living mulch can significantly improve soil properties, reduce weed infestation, and increase maize yield under the Guinea-Sudano savanna conditions of West Africa. However, it could not be implemented due to the late start of the rains. This study was started in 2017 cropping season with data collected in the productivity and environment SI domains leaving out the economic, social and human SI domains. However, the two-year data is not consistent to draw conclusions from. Therefore, a third-year study is required. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | |
| 2.1 Determine the effect of cowpea living mulch on weed control and species richness in a maize-cowpea cropping system | | | | | | | | | | | | | |
| 2.2 Evaluate the effect of cowpea living mulch on soil properties in a maize-cowpea cropping system specifically assessing soil moisture and nutrient variations (details on this are provided in the IITA-KNUST workplan) | | | | | | | | | | | | | |
| 2.3 Determine the effect of cowpea living mulch on maize grain and fodder yields | | | | | | | | | | | | | |
| 2.4 Generate technology extrapolation domains in West Africa | | | | | | | | | | | | | |
| 2.5 Assess the impact of cowpea living mulch on household livelihoods and resilience | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | |
| 3.1 How does cowpea living mulch affect weed control and species richness under maize production? | | | | | | | | | | | | | |
| 3.2 How does cowpea living mulch affect soil moisture and temperature and nutrient fluxes in the root zone? | | | | | | | | | | | | | |
| 3.3 How does cowpea living mulch affect maize yield (in the context of food and feed)? | | | | | | | | | | | | | |
| 3.4 What are the preferences of male and female farmers for cowpea living mulch? | | | | | | | | | | | | | |
| 3.5 Does cowpea living mulch positively enhance farmer adaptation mechanisms during food and feed scarcity and how does it contribute to overall household livelihood and resilience? | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | |
| 4.1 The effect of four levels of cowpea living mulch (No living mulch, cowpea and maize planted on the same day, cowpea planted one week after maize, cowpea planted two weeks after maize) and maize maturity type (Extra-early: Abontem; Early: Omankwa; Medium: Obatanpa) on weed population, soil characteristics and grain yield of maize will be determined using a 4 x 3 factorial treatment arrangement in a strip plot experiment. Trials will be conducted with farmers in the community technology parks and on selected farmers' fields. A gender survey and a farmers' field day will be conducted to evaluate male and female preferences. Technology extrapolation domain will be developed to identify suitable areas for scaling out. Aspects related to soil health will be assessed from quantifying soil moisture retention and nutrient contents in the plots with the living mulch as compared to those without will be monitored. This sub-activity is conducted simultaneously with sub-activity GH121-1901 on assessing the impact of SWC interventions on soil moisture and nutrient fluxes in the farming system. Further details that elaborate on the aforementioned sub-activity are provided in the IITA-KNUST workplan. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment? yes | | | | | | | | | | |  | | |
| 5.1 Weed diversity and biomass, maize grain and fodder yields | | | | | | | | | | | IITA | | |
| 5.2 Gender: access to labor, timing and frequency of farm operations and farmer preference for technology | | | | | | | | | | | IITA | | |
| 5.3 Soil characteristics (temperature, moisture, nutrients) | | | | | | | | | | | IITA, KNUST | | |
| 5.5 Proxies for resilience and livelihood enhancement: labor hours saved, quantity of fodder and number of grazing-free days offered to farmer as a result of cowpea residue, estimated avoided weight loss from number of kilometers an animal would walk in search of fodder, % risk reduction from avoided animal thefts during grazing, and reduced disease risk, number of extra feed days provided by farmer for alternative livelihood options | | | | | | | | | | | All partners | | |
|  | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | | Delivery date | |
| 6.1 Data on agronomic and gender preference for technology | | | | | | Project semi-annual report | | | | | | Mar. 2020 | |
| 6.2 Cost-benefit and labor input data | | | | | | Project semi-annual report | | | | | | Mar. 2020 | |
| 6.3 Technology extrapolation domain | | | | | | Maps | | | | | | Aug. 2020 | |
| 6.4 Database on living mulch in maize | | | | | | Dataverse | | | | | | Dec. 2020 | |
| 6.5 Paper published: Cowpea living-mulch effects on maize grain yield, soil moisture dynamics, weed control and diversity | | | | | | Workshop proceeding  Land Use Policy | | | | | | Dec. 2021 | |
|  | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | | Metrics/Scale | | | | | |
| 7.1 Productivity | | Crop productivity  Crop biomass productivity | | | | | | Grain yield at plot/field level  Stover yield at plot/field level | | | | | |
| 7.2 Economic | | Profitability  Labor requirement | | | | | | Net income at plot/field level  Labor requirement at plot/ field level | | | | | |
| 7.3 Environmental | | Soil chemical quality  Soil physical quality | | | | | | Soil pH and nutrients at plot/ field level  Soil moisture content at plot/ field level | | | | | |
| 7.4 Human | | Food security  Nutrition | | | | | | Calorie production at plot/ field level  Protein production at plot/ field level | | | | | |
| 7.5 Social | | Gender equity | | | | | | Technology rating by gender at plot/ field level | | | | | |

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| --- |
|  |
| 8. How will scaling be achieved? |
| Scaling will be achieved through strategic partnership with private partners such as WorldCover. Knowledge transfer and scaling strategies will include: the establishment of research-for-development plots to demonstrate technologies; participatory and joint learning approaches for technology testing, e.g., Community-based Technology Parks; development of media materials (posters, leaflets, films) for extension staff, farmers, etc.; exchange visits for farmers and researchers; training of trainers and hands-on training for farmers. |
|  |
| 9. How are the activities in this protocol linked to those of others? |
| This sub-activity is linked with soil and water conservation activities as elaborated in the profile of partnerships in Section d. |
|  |
| 10. Custom indicators |
| * Project semi-annual report * Agronomic database * Journal publication * Technology brief |
|  |
| 11. Impact-based summary matrix |
| 11.1 What is the development challenge you are addressing?  Food insecurity and natural resource management |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farmers, extension agents, and policymakers |

|  |  |  |
| --- | --- | --- |
|  | | |
| 12. Budget (US$) | | |
| **Budget line item** | | **IITA** |
| Personnel | | 100800 |
| Services | | 15380 |
| Supplies | | 14000 |
| Capital | | 0 |
| Travel | | 6531 |
| Overhead | | 0 |
| **Total** | | **136,7111** |
| **Grand total** | **136,711** | |
| 1Includes costs of running and maintaining 3 vehicles and 7 motorbikes for the 25 intervention communities in the Northern (Tamale), Upper West (Wa), Upper East (Navrongo) regions, staff costs for postdoc, technicians and drivers, $3,000 for labor monitoring data (Dr. Bekele Kotu), $6,512 for GIS input (Dr. Francis Muthoni) and 1,000 for graduate training, 5,000 for consultancy work for Dr. Gundula Fischer | | |

13. Gantt chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/Month** | **2019** | | | | | | | **2020** | | |  | | | | | | | |
| **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** |
| **GH1111-19** | | | | | | | | | | |  | | | | | | | |
| Farmer sensitization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training of Field Technicians |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field establishment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field monitoring |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Community field days |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Harvesting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data processing and analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Semi-annual report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | |
| a. Output 1.1 | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | |
| b. Activity 1.1.1 | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | |
| c. Sub-activity GH1112-19 | | | Optimizing on-farm nitrogen (N) use efficiency under rainfed condition and leaf stripping for livestock feeding in maize-based cropping system | | | | | | | |
|  | | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | | | Institution | | Role | | | | | |
| Abdul Rahman Nurudeen | | | IITA | | Leader: Cereal agronomy and plant nutrition | | | | | |
| Bekele Kotu | | | IITA | | Economic analysis | | | | | |
| Gundula Fischer | | | IITA | | Gender studies | | | | | |
| Francis Muthoni | | | IITA | | GIS input | | | | | |
| Agyin-Bririkorang Sampson | | | IFDC | | GIS input | | | | | |
| Adda Wesseh | | | UDS | | Livestock nutrition | | | | | |
| Williams Attakora | | | SARI | | Soil fertility and climate change | | | | | |
| Francis Matthey Tetteh | | | SRI | | Soil fertility and soil chemistry | | | | | |
| Benedict Boyubie | | | IITA | | FtF indicators and ensure data upload on Dataverse | | | | | |
|  | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | |
| Name | | | | Institute | | | Degree | Start | | End |
| Sulleyman Kassim | | | | UDS | | | MPhil | 2018 | | 2020 |
|  | | | | | | | | | | |
| f. Location(s) | Northern (Tingoli, Cheyohi no. 2, Doku, Tibali), Upper East (Samboligo, Nyangua, Gia, Bonia), Upper West (Zanko, Guo, Goli, Goriyiri) regions | | | | | | | | | |
|  | | | | | | | | | | |
| g. Start | June 2017 | | | | | | | | | |
|  | | | | | | | | | | |
| h. End | December 2021 | | | | | | | | | |
|  | | | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| Maize is a major staple in West Africa and a heavy feeder of plant nutrients, especially nitrogen (N). Grain yields on farmers’ fields are low due to declining soil fertility. Application of inorganic fertilizer is responsible for large per capita food production in most parts of the world ([[3]](#footnote-3)Sanchez *et al*., 1997 & [[4]](#footnote-4)World Bank, 2017). The Government of Ghana flagship program on Agriculture (Planting for food and jobs) is promoting a new fertilizer mixture (15-20-20 kg/ha NPK + S + MgO + Zn) for cereals (maize, rice, and sorghum) for the 2019 cropping season. However, there is limited evidence on the quality and efficacy of this new fertilizer mixture compared to the best compound fertilizer in the market (YARA Actyva; 23-10-5 NPK + S + MgO + Zn). Therefore, this study will determine the effect of the fertilizer type and management practices on maize growth, yield and N use efficiency under on-farm conditions. This study builds on the results from Africa RISING experiments of N fertilizer rates and variety effect on maize grain yield in northern Ghana (Africa RISING technical report March 2015 and 2016) to apply N fertilizer at 90 kg/ha. The results from this new study would provide empirical evidence to inform policymakers on the effectiveness of the new fertilizer.  This study also builds on the results of maize leaf stripping technology (Africa RISING technical Report March 2018 & 2019) to determine the effect of feeding stripped maize leaves on the growth of small ruminants. Hence the fertilizer trial will be conducted within the experimental design for maize leaf stripping. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | |
| 2.1 Determine the effect of fertilizer type, mode and frequency of its application on growth and yield of maize | | | | | | | | | | |
| 2.2 Evaluate gender preferences for fertilizer type, mode and frequency of its application practices | | | | | | | | | | |
| 2.3 Determine the effect of feeding stripped maize leaves on the growth of small ruminants | | | | | | | | | | |
| 2.4 Assess the impact of the overall technology package on household livelihoods and resilience | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 How does fertilizer type, mode and frequency of its application affect maize growth, yield and N use efficiency? | | | | | | | | | | |
| 3.2 What are the gender preferences for fertilizer type, mode and frequency of its application practices? | | | | | | | | | | |
| 3.3 How does supplementary feeding of stripped maize leaves affect the growth of small ruminants? | | | | | | | | | | |
| 3.4 What is the impact of having closed-loop resource flows when manure from fed animals is returned to the plots, are there any associated tradeoffs? | | | | | | | | | | |
| 3.5 Does maize leaf stripping positively enhance farmer adaptation mechanisms during feed scarcity and how does it contribute to overall household livelihood and resilience? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| The effect of 14 treatments of fertilizer type, time of fertilizer application and frequency of fertilizer applications: Control, New blend (NB) at planting and 5WAP, NB at 2WAP and 5WAP, NB at planting, 2WAP and 5WAP, Compound (CP) at planting and 5WAP, CP at 2WAP and 5WAP, CP at planting, 2WAP and 5WAP, Organic fertilizer, Organic fertilizer + NB at planting and 5WAP, Organic fertilizer + NB at 2WAP and 5WAP, Organic fertilizer + NB at planting, 2WAP and 5WAP, Organic fertilizer + CP at planting and 5WAP, Organic fertilizer + CP at 2WAP and 5WAP and Organic fertilizer + CP at planting, 2WAP and 5WAP) on maize growth, yield and N use efficiency would be determine using strip plot design in community-based technology parks and selected farmers’ fields. Composite soil samples will be taken from the experimental plots before and after harvest to analyze for nutrient content. In addition, greenhouse gas emission (carbon dioxide and nitrous oxide) from the above treatments will also be monitored using the static chamber technique ([[5]](#footnote-5)Clayton *et al*., 1994). A gender participatory evaluation will be conducted during field days to evaluate male and female preferences. The results of the agronomic study will be used in comparison with the soil nutrients maps developed by IFDC to refine and validate findings from the fieldwork. In collaboration with a GIS analyst and guidance from IFDC mapped data, we shall then extrapolate technology domains within the study areas and beyond.  The leaves of maize below the cobs at silking from the farmers’ fields would be stripped for livestock feeding trial to determine the effect of feeding the stripped leaves on the growth of small ruminants using a randomized complete block design. To avoid wastage of scarce feed resources, we shall use an improved feed trough that allows for better intake and reduced feed losses. In addition, we shall assess the fodder biomass and quality and evaluate how much fodder meets the animal’s daily feed requirements and thus how much would be sufficient over a feeding season. This will help unravel and reveal how much crop residue contributes to overall household feed needs for the livestock and subsequently resilience and livelihoods.  We shall assess metrics such as labor saved by farmers for feed searching, enhanced fattening as a result of reduced animal activity in search of fodder under very hot and unfavorable conditions, reduced risks from thefts while browsing and reduced exposure to diseases while scavenging for fodder. While some of the aforementioned metrics are not easy to assess through actual experimental methods, we shall use mixed methods that combine quantitative and qualitative proxies as well as empirical evidence to estimate the associated benefits. | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? yes | | | | | | | |  | | |
| 5.1 Maize grain yield and N use efficiency | | | | | | | | IITA | | |
| 5.2 Net income | | | | | | | | IITA | | |
| 5.3 Soil quality | | | | | | | | KNUST, IITA, SRI | | |
| 5.4 Greenhouse gas (GHG) emission | | | | | | | | SARI | | |
| 5.5 Farmer preference for technology | | | | | | | | IITA | | |
| 5.6 Livestock growth attributes, forage biomass and quality as well as manure quality | | | | | | | | UDS-FA | | |
| 5.7 Proxies for resilience and livelihood enhancement: labor hours saved, quantity of fodder and number of grazing-free days offered to farmer as a result of fodder from stripped maize leaves, estimated avoided weight loss from number of kilometers an animal would walk in search of fodder, % risk reduction from avoided animal thefts while grazing, and avoided disease levels | | | | | | | | All partners | | |
|  | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | Delivery date | |
| 6.1 Data on agronomic and gender preference for technology | | | | | | Project semi-annual report | | | Mar. 2020 | |
| 6.2 Database on Optimizing on-farm N fertilizer use efficiency | | | | | | Dataverse | | | Dec. 2020 | |
| 6.3 Published paper: Optimizing on-farm N fertilizer use efficiency under rainfed condition | | | | | | Agronomy Journal | | | Dec. 2021 | |
| 6.4 Infographic brochure with guidelines and benefits associated with crop-livestock interactions for resilience and livelihoods | | | | | | Brochure distribution list and CG space | | | Nov. 2020 | |
|  | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | |
| Domain | | Indicator | | | | Metrics/Scale | | | | |
| 7.1 Productivity | | Crop productivity  Crop biomass productivity  Livestock productivity | | | | Grain yield at plot/ field level  Stover yield at plot/ field level  Livestock weight gain at farm level | | | | |
| 7.2 Economic | | Profitability  Labor requirement | | | | Net income at plot/ field level  Labor requirement at plot/ field level | | | | |
| 7.3 Environment | | GHG emission  Soil chemical quality | | | | CO2 and N2O emitted at plot/ field level  Soil pH and nutrients at plot/ field level | | | | |
| 7.4 Human | | Food security  Nutrition | | | | Calorie production at plot/ field level  Protein production at plot/ field level | | | | |
| 7.5 Social | | Gender equity | | | | Technology rating by gender at plot/ field level | | | | |

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| 8. How will scaling be achieved? |
| Scaling will be achieved through strategic partnership with private partners such as WorldCover. Knowledge transfer and scaling strategies will include: the establishment of research-for-development plots to demonstrate technologies; participatory and joint learning approaches for technology testing, e.g., Community-based Technology Parks; development of media materials (posters, leaflets, films) for extension staff, farmers, etc.; exchange visits for farmers and researchers; training of trainers and hands-on training for farmers. |
|  |
| 9. How are the activities in this protocol linked to those of others? |
| This sub-activity is linked with livestock feeding activities as elaborated in the profile of partnerships in Section d. |
|  |
| 10. Custom indicators |
| * Project semi-annual report * Agronomic database * Journal publication * Technology brief |
|  |
| 11. Impact-based summary matrix |
| 11.1 What is the development challenge you are addressing?  Food insecurity and natural resource management |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farmers, extension agents, and policymakers |

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| 12. Budget (US$) | | | | | |
| **Budget line item** | | | **IITA** | **SARI** | **UDS** |
| Personnel | | 67200 | 2,000 | 5,000 | |
| Services | | 23070 | 3,000 | 5,000 | |
| Supplies | | 21000 | 0 | 0 | |
| Capital | | 5000 | 0 | 0 | |
| Travel | | 6531 | 2,000 | 2,750 | |
| Overhead | | | 0 | 1050 | 2,250 |
| **Total** | | | **122,8011** | **8,050** | **15,000** |
| **Grand total** | | **145,851** | | | |
| 1Includes costs of running and maintaining 3 vehicles and 7 motorbikes for the 25 intervention communities in the Northern (Tamale), Upper West (Wa), Upper East (Navrongo) regions, staff costs for postdoc, technicians and drivers, $5000 for Soil and fertilizer chemical analysis at SRI, and 4,000 for graduate training. | | | | | |

13. Gantt chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/Month** | **2019** | | | | | | | **2020** | | | | | | | | | | |
| **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** |
| **GH1112-19** | | | | | | | | | | | | | | | | | | |
| Farmer sensitization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training of Field Technicians |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field establishment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field monitoring |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Community field days |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Harvesting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data processing and analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Semi-annual report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | | |
| a. Output 1.1 | | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | |
| b. Activity 1.1.1 | | | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | | | |
| **c.** Sub-activity GH1113-19 | | | | | Assessing the potential for a combination of local Napier grass fodder species and pigeon peas for improved soil health and ruminant productivity in the Guinea savannah zone. | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | | | | |
| Terry Ansah | | | UDS-FA | | | Lead the implementation of the fodder cultivation, data collection and feeding trial and feed quality assessment | | | | | | | | |
| Abdul Rahman Nurudeen | | | IITA | | | Agronomic aspects of pigeon pea intercrop with pastures | | | | | | | | |
| Fred Kizito | | | IITA | | | Contribute to the sub-activity on data analysis and lead in incorporating soil health attributes: soil and water conservation in the fodder cultivation | | | | | | | | |
| Gundula Fischer | | | IITA | | | Support on gender issues relating to the cultivation of pasture | | | | | | | | |
| Bekele Kotu | | | IITA | | | Socio-economic studies and cost-benefit analysis of pasture cultivation | | | | | | | | |
| Benedict Boyubie | | | IITA | | | FtF indicators and ensure data upload on Dataverse | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | |
| Name | | | | Institute | | | Degree | | | | Start | | End | |
| Emmanuel Afrifa | | | | UDS-FA | | | MPhil | | | | 2019 | | 2020 | |
|  | | | | | | | | | | | | | | |
| f. Location(s) | Northern Region (Savelugu District-Duko Technology Park) | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start | August 2019 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End | November 2020 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Natural pasture or rangeland remains the single most important source of forage for ruminants in most developing countries. Rangeland occupies about 54% of the terrestrial ecosystems and sustains approximately 30% of the world’s population (Reynolds *et al.,* 2007[[6]](#footnote-6); Estell *et al*., 2012[[7]](#footnote-7)). Increase in urbanization and competition for land are major threats to the availability of rangelands for livestock production (Oba, 2013[[8]](#footnote-8)). In addition, the adoption of policies that favor crop production over the maintenance of pasture is also gradually reducing the area of land for grazing. It has been estimated that almost 75% of rangelands have been lost to desertification and soil degradation (UNCCD, 2009[[9]](#footnote-9)). It has been observed that in the wet season, access to fodder from rangeland is often limited due to the extensive cultivation of food crops. This has the tendency to affect the productivity of farm animals which will ultimately affect household food security and income.  The introduction of farmers to the cultivation of fodder in the rainy season could augment the supply of biomass and nutrient from crop residues and will also reduce the distance often covered by animals to access fodder from natural sources. The number of children who are often involved in sending animals out for grazing at the expense of their education will be reduced. Conflicts associated with crop destruction by farm animals in the rainy season will be minimized. Milk yield from lactating cows in Ghana is relatively lower and this has been attributed to the low potential of the breeds of cattle in Ghana and most importantly the problem of inadequate nutrition (Digestible protein and metabolizable energy). Inadequate nutrition could also account for a shorter length of lactation in animals leading to reduced milk yield. The consumption of milk, especially among children from cows is very common in most households that keep cows. It has the potential to reduce child malnutrition. Other small ruminant species also play a very important role in ensuring household food security and income.  The survival and productivity of different grass species could be influenced by origin, including temperature, light intensity, total rainfall, soil type, fertilization level, and by stage of maturity. This makes the selection of a suitable fodder species for ruminant livestock production very critical.  Napier grass (*Pennisetum purpureum*), is a high yielding perennial grass native to most African countries including Ghana. Yield is even much higher in areas with a regular supply of water. Annual yields of 85.4 t of dry matter (DM) per ha without fertilizer and up to 130 t DM per ha with 1,320 kg/ha of nitrogen (N) fertilizer have been recorded (Boonman, 1993[[10]](#footnote-10)). The yield of Napier grass can be affected by geographical location, which is largely influenced by temperature, rainfall and N supply (Minson, 1990[[11]](#footnote-11)). Ansah *et al*. (2010[[12]](#footnote-12)) reported yields ranging from 4,863 kg/ha to 44,994 kg/ha of DM in the humid zone of Ghana. In Duko an Africa RISING community in the dry savanna zone of Ghana, Cudjoe *et al.* (2017[[13]](#footnote-13)) reported biomass yields in the range of 1,354 kg DM/ha to 3,339 kg DM/ha with the local variety possessing superior qualities. Napier grass has also been found to be the most effective barrier grass in controlling soil erosion in maize farms in Kenya (Mutegi *et al*., 2008[[14]](#footnote-14)). In addition, the combination of Napier grass with legumes has been reported to increase water stored in the crop root zone (Kizito et al, 2016). We intend to use a dual-purpose legume, pigeon pea (*Cajanus cajan*) which serves as food for farming families and feed for livestock. Although agronomic trials of Napier have been conducted in Ghana, very little has been done on the effect of intercropping *Cajanus cajan* with Napier in the dry savanna zone of Ghana. The rationale for locating this trial in Duko is that there is an irrigation facility that will permit for testing the performance of irrigated fodder out of season. This study will help provide better insights into the merits of the association of Napier grass and pigeon pea. The addition of pigeon pea could potentially help respond to questions that link Africa RISING work to the Innovation Lab for Legume Systems Research. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 Determine the growth characteristics (including recommended coppicing regimes), nutrient composition and in vitro digestibility of the local Napier grass intercropped with or without pigeon pea. | | | | | | | | | | | | | | |
| 2.2 Determine the effect of intercropping on the grain yield, fodder yield and fodder quality of pigeon pea | | | | | | | | | | | | | | |
| 2.3 Determine the effect of the sole Napier grass or intercrop on soil health specifically around soil and water conservation (soil losses and soil moisture) | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | |
| 3.1 Can a combination of Napier grass and pigeon pea enhance fodder yield and quality as well as grain yield? | | | | | | | | | | | | | | |
| 3.2 What is the recommended coppicing regime for Napier grass in order to have optimal results? | | | | | | | | | | | | | | |
| 3.3 Is there an effect of intercropping Napier grass on the grain yield, fodder yield and quality of *pigeon pea*? | | | | | | | | | | | | | | |
| 3.4 What are the effects of sole Napier grass or the combination of Napier grass and *pigeon pea* on soil health? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| **Study area**  The Africa RISING Technology Park in Duko will be selected for this study. Six farmers will be selected to participate in this trial. The rationale for the location of this trial in Duko is that there is an irrigation facility that will permit for testing of the performance of irrigated fodder out of season.  **Cultivation of Napier grass and feeding trial:**  Three out of the six farmers will intercrop Napier grass with *Cajanus cajan* whilst the other three will cultivate sole Napier. An area of 0.25 acre will be cultivated at a distance of 0.5 m x 0.5 m between plants. The *Cajanus cajan* will be introduced after every three rows of Napier grass at a planting distance of 1/1m.  The Napier grass will be allowed 4 weeks to establish during which data on plant height, tiller number, stem diameter will be taken. The grass will be harvested, and biomass yield determined. Subsequent harvests will be done at 4 weeks intervals during the rainy season.  Two weeks after planting the Napier grass, *Cajanus cajan* will be introduced into the field. Data will be collected on germination, date to flowering, plant height and grain yield. Fodder yield from the *Cajanus cajan* will be estimated.  The nutrient composition (Dry Matter, Crude Protein, Neutral Detergent Fiber, Acid Detergent Fiber, Ash) and in vitro digestibility of the harvest fodder in both Napier and *Cajanus cajan* will be determined.  **Effect of sole Napier or intercrop on the soil:**  Prior to the planting of the forages, some soil physio-chemical properties in the upper 0-15 cm of the soil at the will be measured. An access tube will be installed in each plot to monitor soil moisture variations while runoff detectors will be installed in block to monitor soil losses. Soil accumulation, soil losses, soil moisture, percentage soil cover will be measured on all plots.  **Data analysis:**  Napier grass and feeding trial  The data from the agronomic trial and fodder quality will be analyzed by ANOVA. The treatments will be arranged in a three by four completely randomized block design. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | | Responsibility/ Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | | | |  | | |
| 5.1 Data on fodder yield, fodder quality and animal performance | | | | | | | | | | | | Terry Ansah/UDS | | |
| 5.2 Soil health (soil losses, soil moisture) | | | | | | | | | | | | Fred Kizito /IITA | | |
| 5.3 Socio-economic and cost-benefit analysis data | | | | | | | | | | | | Bekele Kotu/IITA | | |
|  | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | |
| Deliverables | | | | | | | | | Means of verification | | | | | Delivery date |
| 6.1 Data on agronomic and gender preference for technology | | | | | | | | | Semi-annual report | | | | | Dec. 2019 |
| 6.2 Cost-benefit and labor input data | | | | | | | | | Semi-annual report | | | | | Feb. 2020 |
| 6.3 Data on fodder yield in relation to ruminant productivity | | | | | | | | | Semi-annual report | | | | | Dec. 2019 |
| 6.4 Training of farmers | | | | | | | | | Training manual | | | | | Feb. 2020 |
| 6.5 Milk yield records | | | | | | | | | Report | | | | | Mar. 2020 |
| 6.6 Soil health data in relation to Napier and Pigeon pea intercrops | | | | | | | | | Semi-annual report | | | | | Mar. 2020 |
| 6.7 Presentation of results at Ghana Animal Science Association conference | | | | | | | | | Book of proceedings | | | | | Aug. 2020 |
| 6.8 Recommendation Booklet: In the context of forage for food, feed and land and water management strategies | | | | | | | | | Semi-annual report | | | | | Nov. 2020 |
| 6.9 Journal article on land and water management strategies using forage legumes and grasses | | | | | | | | | Draft manuscript | | | | | Nov. 2020 |
|  | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | | Metrics/Scale | | | | | | |
| 7.1 Productivity | | Crop productivity  Crop biomass productivity (Napier and pigeon pea) | | | | | | Grain yield at plot/field level  Forage yield at plot/field level | | | | | | |
| 7.2 Environment | | Profitability  Labor requirement | | | | | | Net income at plot/field level  Labor requirement at plot/ field level | | | | | | |
| 7.3 Economic | | Soil chemical quality  Soil physical quality | | | | | | Soil pH and nutrients at plot/ field level  Soil moisture content at plot/ field level | | | | | | |
| 7.4 Social | | Food security  Nutrition | | | | | | Calorie production at plot/ field level  Protein production at plot/ field level | | | | | | |
| 7.5 Human | | Gender equity | | | | | | Technology rating by gender at plot/ field level | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | |
| Scaling will be through MoFA and NGOs working in the livestock sector. In addition, since the trial will be conducted in a Technology Park, we anticipate that visitors coming to this park and the participatory and joint learning approaches from the technology testing will allow for scaling. The development of media materials (posters, leaflets, films) for extension staff, farmers, etc.; exchange visits for farmers and researchers; training of trainers and hands-on training for farmers will also allow for scaling. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| This sub-activity is linked with soil and water conservation (GH1113-19 and GH1212-19) in relation to livestock feeding activities. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | |
| * Recommendation Booklet: In the context of forage for food, feed and land and water management strategies * Journal article on land and water management strategies using forage legumes and grasses | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  This sub-activity addresses improved livestock productivity thereby enhancing household food security and nutrition. | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Smallholder crop and livestock farmers, agricultural extension agents | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | **UDS-FA2** | | | | **IITA** |
| Personnel | | | | | | | | | | 3,000 | | | | 0 |
| Services | | | | | | | | | | 2,000 | | | | 1,000 |
| Supplies | | | | | | | | | | 10,000 | | | | 2,000 |
| Capital | | | | | | | | | | 0 | | | | 1,000 |
| Travel | | | | | | | | | | 2,000 | | | | 1,000 |
| Overhead (15%) | | | | | | | | | | 2,550 | | | | 0 |
| **Total** | | | | | | | | | | **19,550** | | | | **5,000** |
| **Grand total** | | | | | | | | | | **24,550** | | | | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | | **2020** | | | |
| **Aug** | **Sep** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** |
| Field establishment |  |  |  |  |  |  |  |  |
| Monitoring moisture |  |  |  |  |  |  |  |  |
| Monitoring of forage and Pigeon pea growth trends |  |  |  |  |  |  |  |  |
| Training extension agents |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |
| Cost benefit analysis |  |  |  |  |  |  |  |  |
| M&E for verification |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | |
| a. Output 1.1 | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | |
| b. Activity 1.1.1 | | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | | | |
| c. Sub-activity GH1114-19 | | | | Use CCAFS’ Climate-smart village approach to mainstream climate variability in the promotion and dissemination of Africa RISING SI interventions for sustained productivity and reduced risk in Ghana. | | | | | | | | | |
|  | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | | | |
| Samuel Saaka Buah | | | CSIR-SARI | | | Principal Investigator: Responsible for the overall implementation and coordination of sub-activity, data collection, data analysis and final report | | | | | | | |
| Prince M. Entire | | | CSIR-SARI | | | Contribute to cost and benefit analysis, monitoring and evaluation as well as the adoption of the climate-smart agriculture practices | | | | | | | |
| Boasiako Ohene Antwi | | | KNUST | | | Contribution towards the data collection on soil and water management | | | | | | | |
| Abdul Rahman Nurudeen | | | IITA | | | Contribution towards the data collection on agronomy and plant nutrition | | | | | | | |
| Fred Kizito | | | IITA | | | Provide technical backstopping | | | | | | | |
| Mathieu Ouedraogo | | | CCAFS/ICRISAT | | | Contribute to the design of monitoring tool for the modification and adoption of the climate-smart agriculture practices | | | | | | | |
| District Directors | | | Department of the Ministry of Agriculture (DoA) | | | Assists in the dissemination of Africa RISING SI technologies and information through extension services | | | | | | | |
| Benedict Boyubie | | | IITA | | | FtF indicators and ensures uploading data on Dataverse | | | | | | | |
|  | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | |
| Name | | | | | Institute | | Degree | | | Start | | | End |
| Nil | | | | |  | |  | | |  | | |  |
|  | | | | | | | | | | | | | |
| f. Location(s) | Northern (Tingoli, Cheyohi no. 2, Doku, Tibali), Upper East (Samboligo, Nyangua, Gia, Bonia), Upper West (Zanko, Guo, Goli, Goriyiri) regions | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| g. Start | December 2019 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| h. End | May 2021 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | |
| Statement of the problem:  Promotion of climate-smart agriculture (CSA) practices (of which Africa RISING SI technologies form part) remains a global developmental agenda and one mainstream opportunity to mitigate climate change and sustain the productivity of agricultural systems. Considering this need, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has developed the Climate-Smart Village (CSV) approach as a means to agricultural research for development (AR4D) in the context of climate change. It is an approach where CCAFS in partnership with rural communities and other stakeholders (NARES, NGOs, local authorities), tests and validates in an integrated manner, several agricultural interventions that will be brought to scale.  The CSV approach is founded on the principles of participatory action research for grounding research on appropriate and location/context-specific enabling conditions, generating greater evidence of CSA effectiveness in a real-life setting and facilitating co-development of scaling mechanisms towards landscapes, subnational and national levels. The CSV approach has six components: (1) CSA practices and technologies, (2) climate information services and insurance, (3) local and national public and private institutions, (4) national and subnational plans and policies, (5) farmers’ knowledge and (6) climate and development finance. Each of the components mobilizes specific partners including research team, agro-meteorology services, local authorities and development partners. Since 2011, CCAFS has been using the CSV approach in West Africa (Ghana, Senegal, Mali, Niger and Burkina Faso) to test and validate several agricultural interventions with the participation of various local partners. In Ghana, substantial successes have been achieved over the past 7 years where through the CSV, climate information was used as an entry point for informing the choice of CSA technologies that have contributed to improved farm productivity and building resilient livelihoods for poor and marginal farmers. Currently, ESOKO is providing climate information and agro-advisory services for farmers in the CCAFS Climate villages in Lawra and Jirapa districts in the Upper West Region. This could be extended to include farmers in the other AR communities.  In view of the priorities of Africa RISING, CSIR-SARI will use its experiences in promoting and disseminating Africa RISING SI interventions based on local climate variability for sustained productivity and reduced risk in the intervention communities. The implementation of this project is expected to contribute to Outcome 1 of the Africa RISING phase II project: “Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets”. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 2. Objectives: The study seeks to promote and disseminate AR SI interventions based on local climate variability for sustained productivity and reduced risk in the intervention communities. | | | | | | | | | | | | | |
| 2.1 Assess the extent to which AR beneficiaries have embraced SI technologies in order to build their capacities in adaptation planning to climate change. | | | | | | | | | | | | | |
| 2.2 Promote the use of climate information as a basis for farm management decisions | | | | | | | | | | | | | |
| 2.3 Promote the adoption of CSA technologies and practices (of which Africa RISING SI technologies form part) based on local needs for improved adaptive capacity to climate change and variability. | | | | | | | | | | | | | |
| 2.4 Capacitate farmers and extension agents in climate change and climate-smart agriculture through community training with pre-developed content leveraged from CCAFS collaborative activities | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | |
| 3.1 What climate, soil, production and socio-economic factors informed choice and use of AR SI technologies? | | | | | | | | | | | | | |
| 3.2 How does the provision and use of climate information services relate to farm productivity and livelihoods of smallholder farm communities based on the choice of Africa RISING SI technologies? | | | | | | | | | | | | | |
| 3.3 What combinations of Africa RISING SI technologies enhance the adaptive capacity of farmers? | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | |
| 4.1 Baseline assessment, including climate risk analysis and gender and social inclusion analysis;  4.2 Focus group discussion with men and women farmers will be conducted to generate data on social SI indicators and farmers’ views about climate change and variability in general. See Annex I for the detailed protocol.  4.3 Participatory identification and prioritization of Africa RISING SI technologies  based on biophysical, socio-economic, gender, policy and institutional context; also considering possible  synergies and trade-offs amongst individual activities  4.4 Provision of climate information services to farmers using climate forecast communication and the PICSA approach  4.5 Evaluation of portfolios of Africa RISING SI technologies (e.g. providing value-added weather services to farmers, building capacity in climate change adaptation and facilitating community partnerships for knowledge sharing).  4.6 Capacity building for the scaling up of climate-smart interventions through policies and institutions and scaling out to large areas through the farm-to-farm approach.  4.7 Verification demonstrations conducted on two seedbed types (flat vs. tie ridges or Ridges vs. tie ridges) in each community.  4.8 Verification demonstrations conducted on flat vs. earth bunds in each community. The tie ridges and earth bunds are adopted using previous research results in northern Ghana. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | |  | | | |
| 5.1 Crop (Grain and Stover yields kg/ha); Stover is used as livestock feed   * Soil analysis (OC, N, P, K), and soil moisture content * Socio-economic data at field/plot level; labour involved, cost of other inputs such as seed, pesticide and fertilizers (used for economic analysis) * Quantitative and qualitative socioeconomic data (Information on attitudes and opinions on climate change and adaptation) | | | | | | | | | | SARI | | | |
| 5.2 A participatory assessment of the verification demonstrations will be conducted with the communities. Data will consist of disaggregated counts of verified demos. | | | | | | | | | | SARI | | | |
| 5.3 Historic weather information for the project sites and annual weather data throughout the study. Sites will include the AR communities in the NR, UER and UWR | | | | | | | | | | SARI | | | |
|  | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | | | Delivery date | |
| 6.1 Local need of Africa RISING SI technologies based on climate, soil, crop, livestock and socio-economic factors assessed | | | | | | | | Baseline assessment report to be published in CGSpace submitted. | | | | Nov. 2019 | |
| 6.2. Farmers and extension agents trained in climate change and Africa RISING SI technologies | | | | | | | | Training workshop report submitted | | | | Dec. 2019 | |
| 6.3. Farmers received climate information through the climate forecast communication workshop and the PICSA approach | | | | | | | | Activity report submitted | | | | Nov. –Apr. 2020 | |
| 6.4 Two demonstrations on Africa RISING SI technologies established | | | | | | | | Progress and final report submitted | | | | Jun. 2020 | |
| 6.5 Climate-Smart interventions assessed | | | | | | | | Activity report submitted | | | | May-Dec. 2020 | |
| 6.6 Data on technical and agronomic performance of Africa RISING SI technologies interventions. | | | | | | | | Dataverse | | | | Dec. 2020 | |
| 6.7 The use Climate-smart village approach to mainstream climate variability in the promotion and dissemination of integrated crop-livestock-soil systems for sustained productivity and reduced risk in Ghana (data from the previous year) | | | | | | | | Submitted to a Journal | | | | May 2021 | |
| Contribution towards finalization of West Africa Handbook | | | | | | | | West Africa Handbook | | | | Feb. 2020 | |
|  | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | | | Metrics/Scale | | | | |
| 7.1 Productivity | | Crop productivity  Crop biomass productivity | | | | | | | Grain yield (kg/ha) at plot/ field level  Stover yield (kg/ha) at plot/ field level | | | | |
| 7.2 Economic | | Agro-input use (e.g., seed, chemicals), Profitability, Labor requirement,  Income diversification | | | | | | | Input per ha (kg of fertilizer/ha) at plot level,  Net income at plot/ field level  Labor requirement (hours/ha) at plot/ field level | | | | |
| 7.3 Environment | | Soil chemical quality | | | | | | | Soil pH, Total amount of soil Carbon and soil nutrient at plot/ field level | | | | |
| 7.4 Human | | Food security  Nutrition | | | | | | | Food production (Calories/ ha) at plot level  Protein production at plot/ field level  Micronutrient production (g / ha) at plot level | | | | |
| 7.5 Social | | Gender equity | | | | | | | Rating of technologies by gender at household level | | | | |
|  | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | |
| Scaling will be achieved through strategic partnership and by organizing stakeholder meetings with farmers, extension officers and traditional leaders on the results of the trials. Knowledge transfer and scaling strategies will include: the establishment of research-for-development plots to demonstrate technologies; participatory and joint learning approaches for technology testing, e.g. Community-based Technology Parks; development of media materials (posters, fact sheets, policy briefs leaflets, films) for extension staff, farmers, etc.; exchange visits for farmers and researchers; training of trainers and hands-on training for farmers, community outrage programs (Local FM stations) and traditional durbars as well as scientific papers will be used to communicate to the wider public. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | |
| This sub-activity is linked with soil and water conservation and livestock feeding activities as well as other output on integrated management practices and innovations to improve and sustain productivity. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | |
| * Number of demonstrations established * Number of farmers trained * Number of field days organized * Number of meetings/workshops attended * Number of project reports produced * Number of technical leaflets and policy briefs produced * Number of journal articles submitted/published | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Food insecurity, natural resource management, and climate change adaptation.  This sub-activity will address the following major development challenges. (I) food insecurity, (ii) the sub-activity will also reduce the negative effects of climate change and variability on crop productivity, (iii) it will also increase farmers adaptive capacity to climate change and contributes to increasing crop productivity in the area and (iv) increased productivity can also contribute to a profitable crop enterprise thereby improving household income. | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, policymakers, traditional leaders?  The primary beneficiaries include farmers, livestock farmers, and extension agents. The most important include smallholder crop and livestock farmers, extension agents, and policymakers. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | **CSIR-SARI** | | |
| Personnel | | | | | | | | | | | 3,000 | | |
| Services | | | | | | | | | | | 3,000 | | |
| Supplies | | | | | | | | | | | 0 | | |
| Capital | | | | | | | | | | | 2,000 | | |
| Travel | | | | | | | | | | | 2,500 | | |
| Overhead (15%) | | | | | | | | | | | 1,575 | | |
| **Total** | | | | | | | | | | | **12,075** | | |

13. Gantt Chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | **2020** | | | | | | | | | | | |
| **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sept** | **Oct** | **Nov** |
| Needs assessment |  |  |  |  |  |  |  |  |  |  |  |  |
| Farmer engagement |  |  |  |  |  |  |  |  |  |  |  |  |
| Training |  |  |  |  |  |  |  |  |  |  |  |  |
| Assessment of Africa RISING SI technologies |  |  |  |  |  |  |  |  |  |  |  |  |
| M&E for verification |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | | |
| a. Output 1.1 | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | | |
| b. Activity 1.1.1 | | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | | | | |
| c. Sub-activity GH1115-19 and GH1116-19 | | | | GH1115-19: Identify varieties and post-harvest management options of vegetable crop species with adaptation to Northern Ghana in the dry season. | | | | | | | | | | |
| GH1116-19: Determine yield and post-harvest quality of vegetables as affected by improved soil and water management practices in the dry season in Northern Ghana. | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | | Institution | | | | | | Role | | | | | | |
| Jean Baptiste Tignegre | | WorldVeg | | | | | | Sub-activity leader: design protocols; data analysis and write the final report | | | | | | |
| Wubetu Legesse | | WorldVeg | | | | | | Advice and collect data on pests and diseases | | | | | | |
| Edoh Ognakossan Kukom | | WorldVeg | | | | | | Implement postharvest and processing training | | | | | | |
| Alpha Sidy Traore | | WorldVeg | | | | | | Supervise fieldwork and collect data in Mali | | | | | | |
| Paul A. Zaato | | WorldVeg | | | | | | Supervise fieldwork and collect data in Ghana | | | | | | |
| Victor A. Sefa | | WorldVeg Regional Director, WCA-Humid Regions | | | | | | WorldVeg representative for AR project Ghana | | | | | | |
| Kabirou M. N’Diaye | | WorldVeg Regional Director, WCA-Dry Regions | | | | | | WorldVeg representative for AR project Mali | | | | | | |
| Elijah Bobby | | MoFA, Department of Agriculture, Kasena Nakana East, Navrongo | | | | | | Extension agent | | | | | | |
| Benedict Boyubie | | IITA | | | | | | FtF indicators and ensure data upload on Dataverse | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student (s) | | | | | | | | | | | | | | |
| Name | | Institute | | | Degree | | | | Start | | | | End | |
| NIL | |  | | |  | | | |  | | | |  | |
|  | | | | | | | | | | | | | | |
| f. Location(s) | Gia, Nyangua and Tekuru (UER) and Duko (NR) | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start | Oct. 2018 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| f. End | Sep. 2020 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| The dissemination of vegetable technologies (production, post-harvest and processing for household farmers) can improve production, reduce post-harvest losses and generate more income.  A survey conducted in 2015 in Upper East Ghana showed that the key constraints for vegetable production are limited access to improved vegetable species and varieties, vulnerability of the existing varieties to diseases and pests. Farmers also highlighted that high losses due to lack of affordable cooling storage technologies are amongst the major threats to vegetable production. Diseases such as Bacteria wilt and pests such as whiteflies and *Tuta* *absoluta* are amongst the major production constraints in Ghana. *Stemphylum* disease was reported in Ghana on onions. These constraints are aggravated by degraded soils with low water retention capacity. Very low amounts of vegetables produced locally are consumed by households which maintain relatively high malnutrition rates for infants and breast-feeding women.  The proposed activities aim at enhancing vegetable production by increasing the introduction and adoption of improved varieties under integrated pest and disease management, post-harvest technologies and soil management practices. The strategy for improving the nutritional status of the communities will combine awareness communication for behavior change and training of beneficiaries. Vegetable productivity will increase through:   1. Higher production due to the introduction of new varieties/ species. 2. The introduction of integrated pest and disease management (Aphids, thrips, whiteflies’ resistant varieties, Bacteria wilt, virus). 3. The introduction of proper soil management practices which will enhance better growth which reduces the vulnerability to pests and diseases (if specific ones, just mention them) 4. The introduction of post-harvest technologies reducing the losses.   The ways to reach these goals are the implementation of demonstrations, participatory evaluation of technologies and training on good agricultural and post-harvest management practices.  Sub-activity GH1115-19 integrates production, disease and post-harvest management and scaling components.  High beta carotene tomato varieties were introduced in 2017 for the implementation of the nutrition-sensitive agriculture option. These were high yielding lines, but farmers could not sell the extra production because the market did not accept the orange-colored skin. Farmers in Northern Ghana have been facing increasing diseases and pest damages on vegetables (tomato wilting, virus on pepper, whiteflies, Tuta absoluta, etc.). In some areas around dams of UER, farmers abandoned vegetable production due to the high pressure and damages by parasites. In 2018, new lines of tomato and pepper with tolerance to pests and diseases that meet both farmers’ and the market requirements were proposed to farmers in Nyangua or Tekuru (UER) and Duko (NR) to ease technology uptake. The lines proposed for 2019 are the same as those for 2018 to get two years of data. In the meantime, nutrition communication for behaviour change will be implemented to facilitate the adoption of Vitamin A enriched tomatoes. New fresh pepper varieties with higher pungency are proposed to farmers in 2019 for own consumption and the market.  Sub-activity GH1116-19 is new. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 Evaluate varieties of farmers’ and market preferred vegetable species under irrigated conditions through farmer participatory approaches. | | | | | | | | | | | | | | |
| 2.2 Promote information and knowledge exchange among farmers. | | | | | | | | | | | | | | |
| 2.3 Determine the optimum manure use efficiencies and their effects on the post-harvest qualities of tomato, a high-value crop in northern Ghana. | | | | | | | | | | | | | | |
| 2.3 Improve farmers’ capacity on good agricultural practices in vegetable garden techniques, production and post-harvest and processing techniques through the use of effective disease control measures and innovative storage facilities (ZECC). | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions/hypotheses | | | | | | | | | | | | | | |
| 3.1 Our hypothesis is that leaf and/or fruit yield, food and feed nutrients of improved varieties of vegetable varieties will increase significantly from yields of local varieties under irrigated conditions and this will contribute to household food diversity and livelihoods of beneficiaries. | | | | | | | | | | | | | | |
| 3.2 What is the comparative performance of farmers’ and market preferred vegetable species under irrigated conditions? | | | | | | | | | | | | | | |
| 3.3 What strategies can we use to promote information and knowledge exchange on good agricultural, post-harvest practices and processing techniques among participating farmers? | | | | | | | | | | | | | | |
| 3.4 What is the efficacy of the Zero Energy Cooling Chamber (ZECC) towards reduced vegetable post-harvest losses? | | | | | | | | | | | | | | |
| 3.5 What are the most prevailing diseases on vegetables and how can these be controlled effectively during the dry season? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures | | | | | | | | | | | | | | |
| Participatory evaluation and diffusion of promising new vegetable cultivars will be carried out to deliver high value, multiple disease-resistant and nutrient-dense vegetable cultivars. Demonstration on varieties, integrated pest management, adapted storage prototypes and processing technologies will be carried out in the Lead hubs to reduce crop losses, avail healthy products and improve income. Farmers will implement vegetable mono-cropping trials and demonstrations with the dissemination of farmers’ preferred vegetable varieties and species. Fifteen farmers (households) per village in each of the farmers’ communities of the Nyangua, Tekuru, Gia (UER) Duko (NR) (total of 60) will be selected to participate in testing and diffusion of the four most popular vegetable crops (pepper, tomato and onion). In each of the four target communities, improved/validated vegetable varieties and local varieties will be compared and disseminated across subsets of 15 households per village (validated or improved varieties vs. adapted local variety).  About ninety farmers in communities of the Upper East and Northern regions including at least 50% of female farmers and 50% of youth will implement variety trials and demonstrations at the vegetable hubs to disseminate tomato, onion and pepper varieties. In the dry season, about 3 replicated trials will be conducted at these hubs under irrigation. Variety demonstrations will be conducted in the Upper East and Northern regions on selected farmers' fields (with shallow wells, dugouts, dams) to test at least 2 varieties of tomato, onion and pepper and select high-yielding and disease-resistant varieties. A randomized block design with 3 replicates will be used for trials in the vegetable hubs. Farmers will test a single replicate of the above species for at least 3 improved varieties of each species including farmers' variety as control variety. Field days will be organized to document male and female, old and young farmers' preferences for the various technologies and practices. The capacity of vegetable farmers will be improved with training on vegetable gardens. The training sessions will focus on good agricultural practices for the implementation of nurseries, production itinerary, post-harvest handling and vegetable processing technologies.  Six vegetable hubs are available in Northern Region of Ghana equipped with irrigation facilities to host replicated vegetable trials on tomato, pepper and onion. ZECC technology will be tested using the harvested tomato and pepper varieties for improved conservation in four lead hubs. The experiment layout on ZECC in each of the lead hubs will include four treatments: Vegetable stored in ZECC (T1), Vegetable mixed with shea butter wood ash (1:2 w/w) and stored in ZECC (T2), Vegetable mixed with shea butter wood ash (1:2 w/w) and stored in ambient conditions (T3) and Vegetable without any treatment and stored in ambient conditions (T4).  A nursery of 26 new tomato and 14 new pepper varieties will be established in the lead hubs to enable preliminary participatory selection by farmers with regards to diseases and yield performance, market, food and feed suitability. Data will be collected on leaf and fresh fruits yield, plant diseases. Field observation on farmers’ fields and experimental plots will be conducted during the growing season and preliminary identification of diseases will be undertaken based on the symptoms on the plants. In addition, samples will be collected, and identification and characterization of diseases will be done in the laboratory. For the ZECC experiment, data on temperature and relative humidity inside ZECC or in ambient conditions, shelf-life, weight loss, quality parameters (color and total soluble Sugar) will be recorded.  The use of radio sequences as a communication tool by the Nutrition team in the Northern Region of Ghana for communities’ behavior change will cover vegetable intervention areas. Other data: GPS position of farmland; farmers’ sex.  The research for Sub-activity GH1116-19 will be conducted with the participation of farmers to identify scalable technologies in two regions in the Upper East and Northern Regions of Ghana in six lead hubs of Nyangua and Tekuru, Duko, in which, water sources and vegetable growing facilities were built during project phase 1. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | | |
| Is data collection part of a multi-year experiment/ trial? Yes | | | | | | | | | | |  | | | |
| 5.1 Days to 50 % flowering | | | | | | | | | | WorldVeg | | | | |
| 5.2 Number of plants bearing fruits per plot; fruit, bulbs and leaf yields (kg/ha) | | | | | | | | | | WorldVeg | | | | |
| 5.3 Disease & pest incidence (fungi, bacteria, virus, whiteflies, thrips, aphids, mites); new resistance sources | | | | | | | | | | WorldVeg | | | | |
| 5.4 Food quality analysis & nutrients contents as affected by different fertilizer applications (color, total soluble solids, acidity, vitamin C);  Shelf-life (weeks/plot, weight loss (kg/ha), color; Daily temperatures & humidity of ZECC | | | | | | | | | | WorldVeg | | | | |
| 5.5 Soil chemical quality (NPK, pH) total organic matter | | | | | | | | | | WorldVeg/IITA | | | | |
|  | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | | | | Delivery date |
| 6.1 Optimized manure application option improving tomato nutrient qualities during postharvest storage in the ZECC determined for UER and NR. | | | | | | Project interim & full reports | | | | | | | | Jun. 2020 |
| 6.2 Zero energy cooling chambers constructed and evaluated | | | | | | Report on the efficacy of the ZECC technology in two Lead farms or hubs | | | | | | | | Mar. 2020 |
| 6.3 Field days & participatory variety selection organized | | | | | | Project report with a list of participants disaggregated by sex | | | | | | | | Mar. 2020 |
| 6.4 Database on vegetable yields, disease performances under different manure application options and storability | | | | | | Reports; upload on Dataverse | | | | | | | | Jul. 2020 |
| 6.5 Database on farmers training and trial establishment | | | | | | Report included in the full report | | | | | | | | Sep. 2020 |
|  | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | |
| |  |  |  | | --- | --- | --- | | Domain | Indicator | Metric and scale | | | | Indicator | | | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | | | Crop productivity | | | | Fruit yield (kg/ha) at the field/ plot level; fodder yield (kg/ha) | | | | | | | |
| 7.2 Environmental | | | - Prevailing diseases  - Soil quality analysis | | | | - Disease score at plot level  - Soil chemical quality (NPK, pH,) total organic matter at plot level | | | | | | | |
| 7.3 Social | | | - Gender preference for varieties | | | | Field level (variety rank/sex; rank/age) | | | | | | | |
| 7.4 Human | | | -Food quality analysis & nutrients contents as affected by different fertilizer applications | | | | Quality parameters at plot level (color, total soluble solids, acidity, vitamin C)  - weight loss (kg/ha) at farm & plot levels | | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | |
| Scaling activities in 2019-2020 will include partnership with development partners (UDS, Women farmers’ associations in UER, NR, NARES). Knowledge transfer and scaling strategies will include the establishment of research-for-development plots to demonstrate technologies; participatory and joint learning approaches for variety selection in the community-based vegetable hubs as well as farm fields; development by WorldVeg of training of trainers and hands-on training for farmers. The technologies will be also exposed to seed enterprises and food processors during field and open days who will select the best technologies for wider dissemination. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| The results of these sub-activities (IPM, postharvest & processing, soil management options and effects on post-harvest quality) are integrated into the nutrition radio talks by UDS. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | |
| * Number of farmers for which the technology is affordable * Number of farmers for which the technology is available locally | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Low access to quality seeds and improved varieties, (ii) high pressure of diseases & pests no effective control methods and uses of prohibited pesticides (iii) high post-harvest losses by household farmers due to low access to affordable storage facilities, (iv) high rates of malnutrition prevailing for women and infants due to low consumption of vegetables. | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The targeted audience is farmers, extension agents, NGOs, farmers’ associations, local community leaders and policymakers. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | | **WorldVeg** | | |
| Personnel | | | | | | | | | | | | 16,000 | | |
| Services | | | | | | | | | | | | 18,500 | | |
| Supplies | | | | | | | | | | | | 7,000 | | |
| Capital | | | | | | | | | | | | 0 | | |
| Travel | | | | | | | | | | | | 12,500 | | |
| Overhead (22.1%) | | | | | | | | | | | | 11,900 | | |
| **Total1** | | | | | | | | | | | | **65,900** | | |

1Total budget for WoldVeg includes also the support to MoFA for field supervision, fuel and the activities of the management committees in UER and NR of Ghana.

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | **2020** | | | | | | | | |
| **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** |
| Planting nurseries |  |  |  |  |  |  |  |  |  |  |  |  |
| Field preparation |  |  |  |  |  |  |  |  |  |  |  |  |
| Planting/Transplanting |  |  |  |  |  |  |  |  |  |  |  |  |
| Training on good agricultural, post-harvest and processing practices |  |  |  |  |  |  |  |  |  |  |  |  |
| Construction of storage prototypes & trial start |  |  |  |  |  |  |  |  |  |  |  |  |
| Field maintenance (mulching, weeding, fertilizer & insecticide applications) |  |  |  |  |  |  |  |  |  |  |  |  |
| Finalizing book chapter |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and report writing |  |  |  |  |  |  |  |  |  |  |  |  |
| Field day |  |  |  |  |  |  |  |  |  |  |  |  |
| Participatory technologies selection (varieties, storage management options) |  |  |  |  |  |  |  |  |  |  |  |  |
| Data upload in dataverse |  |  |  |  |  |  |  |  |  |  |  |  |
| Report submission (Interim/Final) |  |  |  |  |  |  |  |  |  |  |  |  |
| Meetings and supervision of management committees |  |  |  |  |  |  |  |  |  |  |  |  |
| Preparation of compost for next season |  |  |  |  |  |  |  |  |  |  |  |  |
| Article submission for publication |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | | | |
| a. Output 1.1 | | | | Research products for more productive, intensive, diverse, profitable and resilient crop (cereals, legumes, and vegetables); livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | | | |
| b. Activity 1.1.2 | | | | Test and disseminate a combination of improved breeds, housing, feeding, health and breeding practices to intensify rearing of livestock (sheep, goat, pig, and poultry) for meat, egg and milk production. | | | | | | | | | | | |
| c. Sub-activity GH1121-19 | | | | Assess efficient feed utilization through improved feed troughs. | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | |
| Name | | | | Institution | Role | | | | | | | | | | |
| Augustine Ayantunde | | | | ILRI | Coordination of sub-activity, data collection, data analysis and final report | | | | | | | | | | |
| Sadat Salifu | | | | ARI | Coordination of training of farmers, data collection and report of the training | | | | | | | | | | |
| Solomon Konlan | | | | ARI | Assistance with data collection | | | | | | | | | | |
| Abdul Rahman Nurudeen | | | | IITA | Contribution towards the provision of improved feed for utilization with the feed trough | | | | | | | | | | |
| Bekele Kotu | | | | IITA | Contribute to cost and benefit analysis of the feed troughs | | | | | | | | | | |
| Benedict Boyubie | | | | IITA | Contribute to the design of monitoring tool for the modification and adoption of the improved feed troughs  FtF indicators and ensure data upload on Dataverse | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | |
| Name | | | Institute | | | Degree | | Start | | | | End | | | |
| NIL | | |  | | |  | |  | | | |  | | | |
|  | | | | | | | | | | | | | | | |
| f. Location(s) | Duko and Tibali (Northern Region), Gia (Upper East Region) | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| g. Start | August 2018 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| h. End | June 2020 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | |
| Improved feed troughs for small ruminants were designed based on the specifications from Africa RISING Ethiopia and were demonstrated in three communities within northern Ghana namely: Duko and Tibali (Northern Region) and Gia (Upper East region) involving thirty farmers (10 farmers in each community) between August 2018 and April 2019. Preliminary results from data collected on the use of the improved feed troughs showed that the improved feed troughs reduced feed waste significantly. The quantity of feed wasted was significantly higher with the use of traditional feed troughs than with the use of the improved feed troughs. The percentage of waste in feeding crop residues using the traditional feed troughs was about 31% compared to less than 1% wastage with the improved feed troughs, which implies about 30% feed saved. The farmers mentioned the drastic reduction in feed waste as the main advantage of improved feed troughs. The results also showed that farmers spent less time feeding the animals with the improved feed troughs as they spent much less time to gather the dispersed feedstuffs as with the use of the traditional feed troughs; the time spent feeding the animals was almost halved. The data collection was only conducted in the late dry season and it is necessary to monitor the use of the improved feed troughs across the different seasons (wet, early dry and late dry seasons) to have a correct assessment of the benefit of the technology. In addition, the cost of the improved feed trough for small ruminants is currently high at about Ghc1, 149 (USD 194). Using the locally available construction materials will significantly reduce the costs which will facilitate adoption by the farmers. This sub-activity, therefore, aims at building on the demonstration of the improved feed troughs by collecting additional data on the use across seasons and at the same time monitor the adoption by the farmers within and outside the intervention communities, including modification made to the troughs by the farmers. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | |
| 2.1 The objectives of this sub-activity are: (i) To assess the effect of season on feed utilization and manure production using the improved feed troughs in the 2 regions in northern Ghana (Northern and Upper East regions). (ii) To monitor the adoption of the improved feed troughs within and outside the intervention communities. (iii) To evaluate the potential for use of local materials for the construction of the improved feed troughs including cost and benefit analysis. (iv) Assess the effect of additional researcher modifications (feed trough height, shade, storage options and watering points) on overall feed intake, avoided feed wastage and labor savings based on different gender groups. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | | |
| 3.1 Do seasons affect the quantity of feed that could be saved through improved feed troughs? | | | | | | | | | | | | | | | |
| 3.2 Do improved feed troughs lead to increased manure collection compared to the traditional feed troughs across seasons? | | | | | | | | | | | | | | | |
| 3.3 Who are the adopters of the improved feed troughs and what are the drivers of adoption? What are the constraints to the adoption by non-adopters? | | | | | | | | | | | | | | | |
| 3.4 Does modification of the feed trough offer better feed utilization by small ruminants as well as additional labor savings to the farmer? | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.). | | | | | | | | | | | | | | | |
| Forty-five including the thirty farmers (10 from each community) involved in the demonstration of the use of the improved feed troughs in Duko and Tibali (Northern Region) and Gia (Upper East Region) will be monitored in the wet and early dry seasons over six days consecutively to collect data on feed offered and the leftovers, and time spent feeding compared to the traditional feed troughs. Improved feed resources from work conducted in sub-activity GH111A-18 on leaf stripping and cowpea living mulch will be quantified and fed to small ruminants through the improved feed troughs. Data on feed quality (through a collaborative activity with UDS and IITA) will also be used to inform the overall data analysis on feed use efficiency with improved feed troughs. In addition, manure collected from the animals fed using the traditional and improved feed troughs will be measured during the days of the data collection. To assess the potential of reducing the cost of the improved feed troughs, another five farmers will be selected randomly in each intervention community to build feed troughs with local materials.  The design of the improved feed troughs with locally available materials will follow the same specifications provided by Africa RISING Ethiopia. Data will also be collected on the use of the feed troughs built with the local materials. Data to be collected will include the quantity of feed offered (both in the morning and afternoon) and feed wasted during the feeding process will be measured for six consecutive days, both for the traditional practice (spreading a portion of the feed on the ground) and new troughs. The amount of time spent in looking after the animals while feeding (bringing back dispersed feed, keeping animals to feed comfortably) will be recorded for both practices. A survey questionnaire will be administered to all participating farmers to document their opinions about the contribution of the technology and its acceptance. A simple cost-benefit analysis of the improved feed trough will be conducted. Samples of the feed offered, and the leftovers will be analyzed to assess quality for both improved feed troughs and traditional feeding practice. A survey on the adoption of the technology within and outside the intervention communities will be conducted to characterize the adopters and non-adopters, and the drivers of adoption. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | Responsibility/Institute | | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | | |  | | | | |
| 5.1 Quantity of feed offered and leftovers, chemical composition of feed offered and left-overs, cost and benefit of the improved feed troughs, and time spent feeding the animals by different gender groups. | | | | | | | | | | | ILRI and ARI | | | | |
| 5.2 Quantity and quality of manure produced | | | | | | | | | | | ILRI and ARI | | | | |
|  | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | |
| Deliverables | | | | | | | | | | Means of verification | | | Delivery date | | |
| 6.1 Report of findings on testing and evaluation of the improved feed troughs compared to those built with locally available materials. | | | | | | | | | | Report | | | Mar. 2020 | | |
| 6.2 Data on use of improved feed troughs | | | | | | | | | | Dataverse | | | Mar. 2020 | | |
| 6.3 Data on nutritional value of feed offered and leftovers | | | | | | | | | | Dataverse | | | Mar. 2020 | | |
| 6.4 Data on manure collected | | | | | | | | | | Dataverse | | | Mar. 2020 | | |
|  | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | Metrics/Scale | | | | | | | | |
| 7.1 Productivity | | Input use efficiency (quantity of feed saved from waste; feed use) | | | | | Feed savings (kg dry matter/household/season) at the household | | | | | | | | |
| 7.2 Environmental | | Manure quantity collected  Manure quality | | | | | Manure quantity (kg DM / household)  Manure quality (g/kg DM) | | | | | | | | |
| 7.3 Economic | | Profitability  Labor requirements | | | | | Gross margin of the improved feed troughs at the household level  Farmers’ rating of labor to feed the animals | | | | | | | | |
| 7.4 Social | | Gender equity | | | | | Time spent on feeding the animals by gender in minutes/gender at the household level | | | | | | | | |
| 7.5 Human | | Capacity to experiment | | | | | Number of modifications made to the feed troughs at hh level.  % farmers making modifications at community level | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | |
| Scaling will be done through the partnership with MoFA for the dissemination of the improved feed troughs. Also, scaling will be done through the Youth Empowerment for Life (YEfL), an NGO working on youth issues and whose members were involved in the training on how to design the improved feed troughs. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | |
| This sub-activity is linked to activities on improved crop varieties as the improved feed troughs will be used to feed the crop residues to the animals. This is related to previous work conducted in 2018 under activity 1.1.1: Test and disseminate a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production, specifically to sub-activity GH111A-18: Test, disseminate, and adapt crop, livestock, and integrated crop-livestock technologies and practices to increase and sustain the productivity of smallholder crop-livestock farming systems. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | |
| * Number of adopters of the improved feed troughs * Report on benefits accrued and adaptation options of the improved feed troughs | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed is improved food security for the smallholder crop and livestock farmers as improved feed troughs will enhance feed use efficiency thereby increasing livestock productivity and consequently food security of the farmers. Less feed waste can also contribute to a profitable livestock enterprise thereby improving household income. | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The target audience is smallholder crop and livestock farmers and extension agents. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | **ILRI** | | | | | **ARI1** |
| Sub-total | | | | | | | | | 61,085 | | | | | 21,739 |
| Overhead (15%) | | | | | | | | | 9,163 | | | | | 3,261 |
| **Total** | | | | | | | | | **70,248** | | | | | **25,000** |
| **Grand total** | | | | | | | | | **75,248** | | | | | |

1ARI will be contracted by ILRI

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | | | **2020** | | | | | |
| **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** |
| Design and evaluation including data collection of the use of improved feed troughs and those constructed with local materials |  |  |  |  |  |  |  |  |  |  |  |
| Monitoring of modification and adoption of improved feed troughs |  |  |  |  |  |  |  |  |  |  |  |
| Lab analysis of feed and fecal samples |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | |
| a. Output 1.2 | | | | Integrated management technologies and practices to improve and sustain productivity and ecosystems services of the soil, land, water and vegetation resources are developed and disseminated with farmers and development partners in the intervention communities. | | | | | | | | | |
| b. Activity 1.2.1 | | | | Test and disseminate land, soil and integrated land-soil technologies and practices to improve and sustain productivity and ecosystems services at the farm and landscape/watershed. | | | | | | | | | |
| c. Sub-activity GH1211-19 | | | | Assessing buffer and adaptive capacity to harness the resilience of different farm types. | | | | | | | | | |
|  | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | |
| Name | | | Institution | | | | Role | | | | | | |
| Mirja Michalscheck | | | WUR | | | | Modeling and farmer interaction | | | | | | |
| Jeroen Groot | | | WUR | | | | Activity coordinator | | | | | | |
| Benedict Boyubie | | | IITA | | | | FtF indicators and ensure data upload on Dataverse | | | | | | |
|  | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | |
| Name | | | Institute | | | | | Degree | Start | | | End | |
| Vacant | | | WUR | | | | | MSc | Sep. 2019 | | | Mar. 2020 | |
| Eva Thuijsman | | | WUR | | | | | PhD | Feb. 2019 | | | Feb. 2023 | |
|  | | | | | | | | | | | | | |
| f. Location(s) | Districts in NR, UER, UWR | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| h. End | September 2020 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | |
| Vulnerability and resilience are two crucial attributes of smallholder farming systems that can be used for analyzing the response to disturbances. We will assess these properties in relation to the buffer and adaptive capacity, which depend on the ‘window of opportunities’ of possible changes in terms of productive, socio-economic and environmental performance indicators, i.e. the ‘solution space’. The vulnerability of the system can be quantified as the distance of selected performance indicators between original and disturbed systems. The buffer capacity will be derived from the size of the solution space that could be obtained after reconfiguration of farm components (crops, animals, fertilizers, etc.) that were present on the original farm, whereas the assessment of adaptive capacity was derived in a similar way but after allowing innovation by introducing new components to the farm. These features will be different for the various farm types in the three regions in northern Ghana since they depend on the context (biophysical and socio-economic) and the resources and activities of farms and households. Below we describe the conceptual basis. The activity builds on existing datasets of farm and household structure and farming (from surveys such as GARBES) practices and the proposed and tested Africa RISING technologies (from project scientists).  **Conceptual basis**  A disturbance can be a pest, a drought or a product price decline that negatively affects the farming system performance. The farmer can prepare for or respond to a disturbance by reconfiguring the farm with changes in for instance crop areas, animal numbers, amounts of inputs, selected market channels or management practices to compensate for the effect of the disturbance. The available options for adjustment of the system with existing components and resources can be considered as the ‘buffer capacity’. When the farmer decides to introduce new crops, animals, inputs or practices, the required adjustment and reconfiguration (both in the ecological system and in farm management) is expected to be considerably larger than for the buffer capacity and is reflected in the ‘adaptive capacity’. This illustration of the concepts for an agroecosystem demonstrates that besides the ecological (self-) organization, the farmer, his flexibility and skills, and his cognitive and managerial capacities will determine the chosen strategy of adaptation and the final effectiveness of reconfiguration, and thus agroecosystem resilience.  All possible combinations of values of performance indicators constitute the ‘window of opportunities’ or ‘solution space’ for a particular system. The potential of a system (P), resulting from the buffer and adaptive capacity, can be derived from the size of the solution space, which defines the options for adjustment of the system. The solution space is delimited by the Pareto frontier (or Pareto surface when more than two performance criteria are included in the analysis), and for assessment of resilience, we consider only options that perform at least as good as the existing system. The Pareto frontier can be established using multi-objective optimization, and the area (in 2 dimensions), volume (3 dimensions) or hyper volume (>3 dimensions) of the solution space can be calculated, for instance, relative to a given reference point that represents the existing situation.  This is demonstrated in Figure 1, wherein only the portion of the solution space with improvements in two system indicators (productivity and environmental quality in this case) relative to the existing situation after a disturbance is depicted. The buffer capacity (area B in Figure 1a) is estimated as the solution area corresponding to the reconfiguration of links and flows among the components that are already in the system. The adaptive capacity (area A in Figure 1a) is estimated as the expansion of the solution area when new components are introduced in the system. The potential (P) is estimated as the sum of areas A and B.  Macintosh HD:Users:jeroengroot:Dropbox:Artikelen:027 Resilience:Submitted ES:Figure 1.gif  ***Figure 1.***Portions of solution spaces with future options that perform better for two generic objectives, productivity and environmental quality, relative to disturbed states denoted by red symbols. (a) After a disturbance, the system states change following the arrow from point 1 to point 2 (vulnerability v is the distance between points 1 and 2) and move to a more desirable state such as point 3 (resilience r is the distance between points 2 and 3). Area A represents the adaptive capacity and B the buffer capacity of the system after the disturbance. Potential P is calculated are the sum of areas A and B. White symbols denote alternatives for the current system. (b) The potential of a system at consecutive moments in time, with changing attained states (points 1, 3, 5 and 7) and after disturbances (points 2, 4 and 6). | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | |
| 2.1 Analyze input-output relations for farm production activities (cropping, animal husbandry, etc.) | | | | | | | | | | | | | |
| 2.2 Quantify potential effects of disturbances on-farm production activities for multiple performance indicators | | | | | | | | | | | | | |
| 2.3 Model farm/household level effects of disturbances to assess vulnerability for different farm types | | | | | | | | | | | | | |
| 2.4 Quantify the buffer and adaptive capacity of farms and households of different types | | | | | | | | | | | | | |
| 2.5 Establish pathways to harness farm and household resilience for different farm types | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | |
| 3.1 To what extent are productive, socio-economic and environmental performance indicators at the farm and household level affected by biophysical and socio-economic disturbances (e.g. drought, price fluctuation) | | | | | | | | | | | | | |
| 3.2 What are the buffer and adaptive capacity of different farm and household types for disturbances in terms of selected productive, socio-economic and environmental performance indicators? | | | | | | | | | | | | | |
| 3.3 Which efficient pathways for performance improvement can be used to recover after disturbances by different types of farms or households? | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 4. Procedures(survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | |
| * FarmDESIGN modeling using existing parameterized farms/ households for three farm types per region * Inventory of production activities that are used on farms or tested by the project (technologies), these production activities (inputs and outputs) are added to the farm models as input data but can also be used to validate the models * Individual discussions and focus group discussions with farmers and experts to assess the feasibility of changes pathways to harness resilience * Surveys, focus group discussions, farming systems modeling and a serious game. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded to Dataverse | | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/ trial? Yes | | | | | | | | | | |  | | |
| 5.1 Parameterized model for various farm types per region | | | | | | | | | | | WUR | | |
|  | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | |
| Deliverables | | | | | Means of verification | | | | | | Delivery date | | |
| 6.1 Journal article | | | | | PDF of the submitted paper | | | | | | Sep. 2020 | | |
| 6.2 MSc thesis student report | | | | | PDF of report | | | | | | Sep. 2020 | | |
|  | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | |
| Domain | | Indicator | | | | Metrics/Scale | | | | | | | |
| 7.1. Productivity | | Crop productivity | | | | Crop yields (kg/ha/year) under regular and disturbed conditions (at field and farm levels) | | | | | | | |
| Animal productivity | | | | Animal products (kg/animal/year) under regular and disturbed conditions (at animal and farm levels). | | | | | | | |
| Input use efficiency | | | | Product per input (at field, herd and farm levels) | | | | | | | |
| 7.2. Economic | | Profitability | | | | Gross margin of crop and animal operations and operating profit of farm operation (USD) | | | | | | | |
| Labor requirement | | | | Labor requirements at field, animal, herd, farm and household levels | | | | | | | |
| 7.3 Environment | | Soil chemical quality | | | | Carbon and nutrient (N, P, K) budgets, losses to air and soil (at field and farm levels) | | | | | | | |
| 7.4 Human condition | | Nutrition | | | | Nutrient production (kg/year) at field and farm levels | | | | | | | |
| Food security | | | | Food production (kcal/year) at field and farm levels | | | | | | | |
| Capacity to experiment | | | | Willingness to implement a new farm configuration after disturbance | | | | | | | |
| 7.5 Social | | Equity | | | | Rating of farm configurations per group and agency (leadership roles) | | | | | | | |
|  | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | |
| Our assessment builds upon a locally validated but general pattern of inter- and intra-household diversity. Since our case study households have been selected as representative for farm types of different resource endowment, we expect our findings to be relevant to most other farms of the same type. (We envision to test the transferability of our results by Focus Group Discussions and individual consultations beyond the current case study site in order to ensure greater validity.) Our findings are meant to guide Africa RISING’s scaling effort, in that we reveal how the resilience of the different farm and farmer types can be improved best by which of the Africa RISING technologies. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | |
| The modelling exercise builds on past and ongoing Africa RISING trial data i.e. data from the technology parks as well as the farmer-led baby- and upscaled trials. The models will be updated, extended and tested in close collaboration with the Africa RISING-regional coordinators and other project experts in Tamale (NR), Navrongo (UE) and Wa (UW). | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | |
| * Journal article * MSc thesis student report | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed is improving our understanding of how smallholder farming systems respond to disturbances and assess their vulnerability and resilience. | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The target audience is smallholder crop and livestock farmers and extension agents. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | **WUR (FSE)** | | | **WUR (PPS)** |
| Personnel | | | | | | | | | | 21,000 | | | 0 |
| Services | | | | | | | | | | 0 | | | 4,025 |
| Supplies | | | | | | | | | | 0 | | | 11,500 |
| Capital | | | | | | | | | | 0 | | | 0 |
| Travel | | | | | | | | | | 3,000 | | | 3,000 |
| Overhead | | | | | | | | | | 3,150 | | | 0 |
| Total | | | | | | | | | | **27,150** | | | **18,525** |
| **Grand total** | | | | | | | | | | **45,675** | | | |

13. Gantt chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Activity** | **Year** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | |
| **Month** | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
| Starting | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Preparation of farm modelling | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field work in three regions | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Processing and reporting results | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Drafting paper for scientific journal | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Revising paper and submission to journal | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ending | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | |
| a. Output 1.2 | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | |
| b. Activity 1.2.1 | | Test and disseminate land, soil and integrated land-soil technologies and practices to improve and sustain productivity and ecosystems services at the farm and landscape/watershed levels. | | | | |
| c. Sub-activity GH1212-19 | | Assess the impact of soil and water conservation interventions in a maize - cowpea living mulch system. | | | | |
|  | | | | | | |
| d. Research team | | | | | | |
| Name | | Institution | Role | | | |
| Wilson Agyei Agyare | | KNUST | PI: Soil and water management | | | |
| Fred Kizito | | IITA | Co-PI: Land and water management | | | |
| B. O. Antwi | | SRI | Soil and water management | | | |
| Abdul Rahman Nurudeen | | IITA | Cereal agronomy and plant nutrition | | | |
| Gundula Fischer | | IITA | Gender and social aspects | | | |
| Benedict Boyubie | | IITA | FtF indicators and ensure data upload on Dataverse | | | |
|  | | | | | | |
| e. Student(s) | | | | | | |
| Name | | Institute | | Degree | Start | End |
| Ernestina Anan | | KNUST | | MPhil | 2018 | 2020 |
|  | | | | | | |
| f. Location(s) | Northern Region (Tingoli, Cheyohi no. 2, Doku, Tibali), Upper East Region (Nyangua, Bonia) | | | | | |
|  | | | | | | |
| g. Start | July 2017 | | | | | |
|  | | | | | | |
| h. End | December 2020 | | | | | |
|  | | | | | | |
| 1. Justification | | | | | | |
| This is the final year that this sub-activity, previously 1.2.1-1801, will be implemented. The sub-activity builds on previous work and allows for assessing soil moisture and nutrient flux benefits associated with a maize-cowpea living mulch whereby the cowpeas are considered as the living mulch. This sub-activity is conducted in conjunction with sub-activity GH1112-19 entitled: Test, disseminate and adapt crop, livestock and integrated crop-livestock technologies and practices to increase and sustain the productivity of smallholder farming systems. Sub-activity GH1112-19 will assess complementary soil health metrics and animal feed information that provide vital metrics to support our experimental and modeling approaches. | | | | | | |

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| 2. Objectives |
| 2.1 Assess soil moisture and nutrient flux benefits associated with a maize-cowpea living mulch intercrop |
| 2.2 Map, engage and collaborate with strategic partnerships as a means to scale out promising SWC measures |
| 2.3 Refine content from the already submitted West Africa Handbook Chapter on Land &water management strategies in Cereal-Legume farming systems |
|  |
| 3. Research Questions |
| 3.1 How much soil moisture is retained/increased/depleted within maize-cowpea living mulch systems and how does this impact on corresponding crop yields? |
| 3.2 What would be the best strategy to map, engage and collaborate with strategic partnerships in the Region as a means to scale out promising SWC measures? |
|  |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) |
| Presented as activity with its associated data:  4.1 Assessing combinations of soil and water conservation measures:   * Soil losses will be monitored by a modified version of a calibrated runoff soil loss detector that captures 75% of the plot runoff zone (in the Upper East Region) * Climatic variables: Rainfall, air temperature, wind speed and relative humidity for crop evapotranspiration measurements * Nutrient dynamics will be monitored using suction lysimeters which will be held at a tension of 70 cbars and installed at varying depths along the profiles of interest in order to ascertain fate and transport as well as verify what percentage is captured within the crop root zone * Soil moisture will provide vital links to both soil and nutrient losses. Soil moisture will be monitored using a diviner probe (Sentenk Inc.) to depths of 1.6 m at 10 cm increments within the profile. Access tubes for moisture measurement with the diviner probe will be installed in the center position of the target plots * Data on hydraulic properties such as Infiltration rates monitored with a portable mini disk infiltrometer, soil hydraulic conductivity (auger hole method), and dry bulk density will be collected. These data will explain the drying cycle of available water in the soil for rain events.   4.2 We shall assess the knowledge, attitude, skills and aspirations (KASA) of farmers before and after the training and capacity building exercises. The activity will take care of the training and capacity building needs of all the other sub-activities by the team. |

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| 5. Data to be collected and uploaded on Dataverse | | | | | Responsibility/Institute | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | |  | |
| Soil loss, soil moisture content, nutrient variations, soil hydraulic properties. | | | | | KNUST/IITA | |
|  | | | | |  | |
| 6. Milestones | | | | | | |
| Deliverables | | Means of verification | | | Delivery date | |
| 6.1 Database on land and water management strategies in cereal-legume farming systems | | Dataverse | | | Feb. 2020 | |
| 6.2 Publication on land and water management strategies in cereal-legume farming systems | | Journal Article | | | Jun. 2020 | |
| 6.3 West Africa Handbook Chapter: Land and water management strategies in Cereal-Legume based farming systems | | Updated and completed handbook chapter | | | Mar. 2020 | |
|  | |  | | |  | |
| 7. Sustainable intensification indicators | | | | | | |
| Domain | Indicator | | Metrics/Scale | | | |
| 7.1 Productivity | Crop productivity | | Yield (kg/ha/season) at the field/plot level | | | |
| 7.2 Environmental | -Erosion  -Soil water storage | | -Soil loss (tons/ha/season) at the plot level  - Seasonal soil moisture storage mm/m | | | |
| 7.3 Economic | - Profitability  - Input Use Intensity | | - Net income ($/crop/ha/season) at the plot level  - Input per ha at the plot level | | | |
| 7.4 Social | - Gender equity  - Collective action | | -Capacity: Access to information (Household)  - Participation in a collective action group (Household) | | | |
| 7.5 Human | Capacity to experiment | | - Number of new practices being tested (Household level)  -% of farmers experimenting (Community level) | | | |
|  | | | | | | |
| 8. How will scaling be achieved? | | | | | | |
| Strategic partnerships with both public and private sector entities for the public sector: we shall liaise with MoFA, the private sector specifically WorldCover and local universities. This will include sharing with them brochures developed for farmer training as well as co-sharing in-field experiences at working group discussions including Agriculture Extension Officers as key change agents. | | | | | | |
|  | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | |
| The activities are related to sub-activity GH1111-19 entitled “Cowpea living mulch effect on weed control, soil properties and maize yield”. This is an integrative activity in which IITA, and KNUST will collaborate on soil and water conservation incorporation within farming systems. The work also closely links with IITA on cereal-legume cropping systems and will mimic the soil and water conservation approaches that incorporate living mulch in farming systems that have been successfully implemented previously in West Africa. Insights from our work will be shared with IWMI for cross-learning opportunities between soil/land management strategies and water management interventions within the target farming systems. | | | | | | |
|  | | | | | | |
| 10. Custom indicators | | | | | | |
| * Journal article on land and water management strategies in Cereal-Legume based farming systems * Handbook chapter for West Africa * Database on land and water management strategies in Cereal-Legume based farming systems | | | | | | |
|  | | | | | | |
| 11. Impact-based summary matrix | | | | | | |
| 11.1 What is the development challenge you are addressing?  Food insecurity and poverty (household level) and NRM (from plot level to landscape level) Through this research, the sub-activity will seek and subsequently share information that preserves the natural resource base through soil conservation thus increasing productivity and contribute towards reducing food insecurity and poverty. | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Smallholder farmers, agricultural extension agents | | | | | | |
|  | | | | | | |
| 12. Budget (US$) | | | | | | |
| **Budget line item** | | | | **IITA** | | **KNUST** |
| Personnel | | | | 2,000 | | 3,900 |
| Services | | | | 4,000 | | 760 |
| Supplies | | | | 3,000 | | 1,000 |
| Capital | | | | 2,000 | | 2,000 |
| Travel | | | | 2,000 | | 900 |
| Overhead | | | | 0 | | 880 |
| **Total** | | | | **13,000** | | **9,440** |
| **Grand total** | | | | **22,440** | | |

13. Gantt chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | | | **2020** | | | |
| **Jul** | **Aug** | **Sep** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** |
| Field establishment |  |  |  |  |  |  |  |  |  |
| Monitoring moisture |  |  |  |  |  |  |  |  |  |
| Monitoring nutrient fluxes |  |  |  |  |  |  |  |  |  |
| Training |  |  |  |  |  |  |  |  |  |
| Finalizing content of Technology Handbook chapter (Includes support to other Handbook chapters) |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | |
| a. Output: 1.2 | | | | Integrated management technologies and practices to improve and sustain productivity and ecosystem services of the soil, land, water and vegetation resources are developed and disseminated with farmers and development partners in the intervention communities. | | | | | | |
| b. Activity 1.2.2 | | | | Test and promote water management technologies and practices to increase water productivity in the small-scale crop-livestock farming systems under rainfed and irrigated conditions. | | | | | | |
| c. Sub-activity GH1221-19 | | | | Evaluate the technical and agronomic performance of Bhungroo and solar-energy drip irrigation system in the Upper East Region of Ghana. | | | | | | |
|  | | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | | Institution | | | Role | | | | | |
| Zenebe Adimassu | | IWMI | | | Principal Investigator: Responsible for the overall implementation and coordinating the project | | | | | |
| Eric Nartey | | IWMI | | | The research officer will assist technical issues of the project, including field preparation, planting, data collection, etc. | | | | | |
| Charity Osei | | IWMI | | | The researcher will be involved in the identification, data collection and analysis of SI indicators mainly on social and human condition to evaluate holistic sustainability of the interventions | | | | | |
| Benedict Boyubie | | IITA | | | FtF indicators and ensure data upload on Dataverse | | | | | |
|  | | | | | | | | | | |
| f. Location(s) | Sepaat and Gorogo communities, Upper East Region, Ghana | | | | | | | | | |
|  | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | |
|  | | | | | | | | | | |
| h. End | May 2021 | | | | | | | | | |
|  | | | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| Northern Ghana is the agricultural production hub of the country, creating employment for the majority of the adult population. Unlike the south where two rainfall patterns are experienced, Northern Ghana has only one rainy season within which farmers maximize production before the dry season sets in. This notwithstanding, the rainy season also comes with some challenges. For example, there are heavy floods during the rainy season, which destroy farmlands, farm produce and infrastructure (Ofosu-Antwi *et al*., 2017)[[15]](#footnote-15). Again, many farms are waterlogged, and tillage is delayed or made difficult. These occurrences go a long way to affect livelihoods of especially smallholder farmers in terms of food security and incomes.  Irrigation development offers the promise of food security and poverty alleviation in northern Ghana. However, all rivers except the Volta and its major tributaries dry up in the dry season. Farmers practicing dry season production, therefore mostly rely on shallow groundwater, which normally dries up before the end of the dry season (Maisiri *et al*., 2005)[[16]](#footnote-16). It is against this backdrop that the Bhungroo technology was introduced to provide a reliable water supply for dry season crop production through aquifer storage and recovery. The concept of enhancing groundwater recharge through the Bhungroo technology for dry season crop production started with the implementation of the “Enhancing ecosystem services for smallholder women farmers in the northern region of Ghana through an integrated Bhungroo based research” project funded by the CGIAR Research Program on Water, Land and Ecosystems (WLE). This project resulted in the construction of two Bhungroo systems.  A follow-up to this project was the “Securing Water for Improved Seed and High-Value Vegetable Production in Flood-prone areas of Northern Ghana” (SecureWater) Project funded by the Agriculture Technology Transfer Project (ATT) led by the International Fertilizer Development Centre (IFDC). The project was implemented by the International Water Management Institute (IWMI) in partnership with Conservation Alliance (CA) and Ghana Irrigation Development Authority (GIDA). In total, the two projects installed five solar-powered and one diesel-powered pump in six communities. Although two solar-powered Bhungroo-based irrigation systems were constructed under this project in the Upper East Region, the system has not been used to grow crops during the project time span. This is mainly because of the fact that the project ended before starting the field trials in this Bhungroos. Hence, the aim of this activity is to test the technical and agronomic performances of the newly constructed Bhungroo and solar-based irrigation systems to strengthen the existing data generated from other sites.  The ultimate aim is to generate robust data to develop Bhungroo based and solar-powered irrigation business models (including economic feasibility) for northern Ghana and beyond. Most farmers in the region rely on their judgement and apply high volumes of water to make up for losses due to high evapotranspiration in the dry season without regard to the actual water requirement of the crop thus resulting in very low efficiencies. Although water management solutions offer greater security to agricultural production and expand the options for sustaining livelihoods as well as ensuring food security and nutrition (Domenech, 2014)[[17]](#footnote-17), the efficiency of water in agricultural production is low at farm level. Generally, the crop effectively uses only 40 to 60% of the water applied, the rest is usually lost through various processes including evaporation, runoff, and percolation into the groundwater. It is crucial to ensure that the right amount of water is applied at the right time to avoid waste of water and energy. This can be achieved using drip irrigation and deficit irrigation technologies.  Drip irrigation allows controlling precisely the application of water by allowing water to drip slowly near the plant roots through a network of valves, pipes, tubing, and emitters (Burney, 2012)[[18]](#footnote-18). With limited water available during the dry season and the high capital investment costs of the Bhungroo and solar-based irrigation system, it is imperative that the water is used wisely and with the highest possible efficiency to generate the highest possible return on investment. This triggers the use of efficient water application methods such as drip irrigation system. The main benefit obtained from the system is the opportunity to do dry season irrigation of high-value crops. The experiments aim to evaluate the technical and agronomic performance of Bhungroo and solar-based irrigation. Moreover, this research generates input data for the development of business models related to solar-powered irrigation systems in north Ghana and similar agro-ecologies. This activity benefited from the Bhungroo and solar irrigation infrastructure, which was funded by WLE and Secure Water projects. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | |
| 2.1 Evaluate the technical and agronomic performance of solar-powered drip irrigation system in two communities | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 How effective is Bhungroo and solar-based energy under the different drip irrigation system? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| The study will be conducted using four irrigation regimes in two communities (Sepaat and Gogoro). The four irrigation regimes include i) Drip 1 (100% of the Crop water requirement), ii) drip 2 (80% of crop water requirement, iii) drip 3 (65% of the crop water requirement), iv) Farmers’ practice. The deficit irrigation treatments (85% and 65%) are adopted using previous research results such as Liu *et al*. (2006)[[19]](#footnote-19) and Kang *et al*. (2000)[[20]](#footnote-20).  Youths will be involved in the experiment in both sites. In both communities, youths will be organized and training on Bhungroo and solar-based drip irrigation system.  At least 60 farmers (30 at each site) will directly be involved in the demonstration.  Focus group discussion with men and women farmers will be conducted to generate data on social SI indicators and farmers’ views about the irrigation system in general. See Annex I for the detailed protocol. | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse[[21]](#footnote-21) | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | |  | | |
| * Yield (kg/ha)] at each harvest * Irrigation quantity applied and frequency * Fertilizer (type, quantity) * The labor involved * Cost of other inputs such as seed, pesticide and fertilizers (used for economic analysis in year 2) * Cost of drip kits, solar panels, Bhungroo (used for economic analysis in year 2) * Soil analysis (OC, N, P, K) * Is data part of a multiyear experiment/trial? Yes | | | | | | | | IWMI | | |
|  | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | Delivery date |
| 6.1 Data on technical and agronomic performance of Bhungroo and solar-based drip irrigation system | | | | | | | Dataverse | | | Jul. 2020 |
| 6.2 Report on the performance of Bhungroo and solar-based drip irrigation in the dry season | | | | | | | Project report to be published in CGSpace submitted | | | Jun. 2020 |
| 6.3 Two demonstrations established | | | | | | | Progress and final report submitted | | | Jun. 2020 |
| 6.4 Paper: The use of Wetting Front Detector as an irrigation-scheduling tool: evidence from field experiment and farmers’ views  (data from the previous years) | | | | | | | Submitted to a Journal | | | Jun. 2020 |
| 6.5 Finalization of the West Africa Handbook as a team collaboration with the co-authors | | | | | | | Chapter revision updates | | | Jun. 2020 |
|  | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | |
| Domain | | | Indicator | | | Metrics/Scale | | | | |
| 7.1 Productivity | | | Crop productivity | | | Yield (kg/ha/season) at the field/plot level | | | | |
|  | | | Input use efficiency | | | kg grain/kg nitrogen, phosphorus, potassium, input per season; kg grain/litre of irrigation water per season at the plot level | | | | |
| 7.2 Environmental | | | Soil carbon | | | % C, Total amount of soil carbon at the plot level | | | | |
| Soil nutrients | | | Soil nutrient levels at plot level | | | | |
| 7.3 Economic | | | Input use intensity | | | Input per ha (kg of fertilizer/ha, m3 of water/ha) at plot level | | | | |
|  | | | Labor requirement | | | Labor requirement (hours/ha) at plot level | | | | |
| 7.4 Social | | | Gender equity | | | Rating of technologies by gender at household level | | | | |
| 7.5 Human | | | Nutrition | | | Protein production (g/ha), Micronutrient production (g/ha) at plot level | | | | |
|  | | | Food security | | | Food production (calories/ha) at plot level | | | | |
|  | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | |
| Scaling will be achieved by, organizing stakeholder meetings with farmers and extension officers on the results of the trials, the preferred water lifting and application methods during the dry season. Once the technology is verified, the project team will share research result and engage with potential scaling partners such as regional offices of MoFA (Ministry of Food & Agriculture) and GIDA (Ghana Irrigation Development Authority). Co-generation of knowledge through on-farm demonstration will be used to scale out innovative technologies. Fact sheets, workshops, policy briefs, as well as scientific papers will be used to communicate to the wider public. | | | | | | | | | | |
|  | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | |
| This sub-activity experiment is linked to previous work conducted by IWMI on water resources use within vegetable systems. In addition, it is linked to sub-activities planned by the World Vegetable Center under GH1115-19 and GH1116-19. The outcomes of this research help to disseminate vegetable production in the Upper East Region of Ghana and other similar areas in Ghana and beyond. | | | | | | | | | | |
|  | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | |
| * Number of demonstrations established * Number of farmers trained * Number of field days organized * Number of meetings/workshops attended * Number of project reports produced * Number of journal articles submitted/published | | | | | | | | | | |
|  | | | | | | | | | | |
| 11. Impact based summary matrix  11.1 What is the development challenge you are addressing?  This sub-activity will address the following major development challenges. i) The Bhungroo system recharges groundwater and drains flooded areas. ii) the sub-activity will also reduce water shortage using efficient water application technics such as drip irrigation, iii) since the sub-activity uses solar energy for water lifting, it avoids the use of diesel/petrol energy, and iv) it also increases irrigation agriculture in the dry season and contributes to increase vegetable production in the area. | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The most important include small-scale farmers, extension agents, policymakers and private sector who are working on irrigation and solar business. | | | | | | | | | | |
|  | | | | | | | | | | |
| **12. Budget (USD)** | | | | | | | | | | |
|  | | | | | | | | | **IWMI** | |
| Personnel | | | | | | | | | 74,500 | |
| Services and Operation | | | | | | | | | 31,904 | |
| Supplies | | | | | | | | | 3,276 | |
| Capital | | | | | | | | | - | |
| Travel | | | | | | | | | 6,700 | |
| Overhead | | | | | | | | | 18,620 | |
| **Total** | | | | | | | | | **135, 000** | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Year** | **2019** | | | | | **2020** | | | | |
| **Month** | **Jul** | **Aug** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** |
| Land preparation | |  |  |  |  |  |  |  |  |  |  |
| Field establishment including planting | |  |  |  |  |  |  |  |  |  |  |
| Checking and maintaining the solar pumps | |  |  |  |  |  |  |  |  |  |  |
| Installing the drip system | |  |  |  |  |  |  |  |  |  |  |
| Training and demonstration of technologies | |  |  |  |  |  |  |  |  |  |  |
| Data collection | |  |  |  |  |  |  |  |  |  |  |
| Data analysis and report writing | |  |  |  |  |  |  |  |  |  |  |
| Reporting | |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 2: More farmers and farm families in the intervention communities are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | | | |
| a. Output 2.1 | | | | Improved technologies, innovations, practices and habits to increase production and consumption of safe diverse and more nutritious food for farm families, especially women and children, developed and disseminated in partnership with research and development partners. | | | | | | | | | | |
| b. Activity 2.1.2 | | | | Train farm families, especially women, to produce and consume more diverse and nutritious food. | | | | | | | | | | |
| c. Sub-activity GH2121-19 | | | | Promote the empowerment of through radio for improved nutrition outcomes. | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | | Institution | | | | Role | | | | | | | | |
| Mahama Saaka | | UDS-SoH | | | | Sub-activity leader: Coordinates the design, implementation and evaluation of activities | | | | | | | | |
| Anthony Kulla | | Ghana Health Service | | | | Assists with training of women’s groups, data collection and compilation of monthly reports on activities | | | | | | | | |
| Christiana Azupio | | Ghana Health Service | | | | Monitor subdistrict field activities including delivery of nutrition education, growth monitoring and home visits | | | | | | | | |
| Scriptwriters | |  | | | | Translate nutrition messages into local dialects | | | | | | | | |
| Benedict Ebito Boyubie | | IITA | | | | Develop data collection tools, train the research team on Feed the Future indicators and support in data collection to track output level and Feed the future indicators.  Ensuring data upload on Dataverse | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | |
| Name | | | | | Institute | | | | Degree | | Start | | | End |
| NIL | | | | |  | | | |  | |  | | |  |
|  | | | | | | | | | | | | | | |
| f. Location(s) | 25 communities in 5 districts (Savelugu, Tolon, Wa West, Nadowli and Kassena-Nankana) of northern Ghana (This expands beyond the 12 Africa RISING communities) | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start | July 2018 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End | May 2020 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Childhood malnutrition is a global public health problem in many parts of the world including northern Ghana. Potential interventions and strategies are being sought for a lasting solution. One such intervention is the promotion of women’s empowerment as an important point for improving nutrition (Ruel M.T., Alderman, H., 2013[[22]](#footnote-22)). There is evidence of a positive association between women’s empowerment and improved nutrition outcomes of women and for their families[[23]](#footnote-23) and that education and women’s knowledge of nutrition are key ingredients for successful women’s empowerment[[24]](#footnote-24)**.** However, the evidence backing the effect of women’s empowerment in agriculture on malnutrition appears to be context-specific and results are inconsistent and therefore warrants more research.  Women are central actors in achieving better household nutrition[[25]](#footnote-25). Aside from being child bearers and caregivers with a more direct inﬂuence on fetal and infant health, women choose to allocate more resources than men toward their family's health and nutrition[[26]](#footnote-26). However, given persistent gender inequalities in many developing countries, women often lack the autonomy and decision-making power within the household to make key decisions leading to better health and nutritional outcomes[[27]](#footnote-27), and the resources with which to implement those decisions. Therefore, empowering women is increasingly recognized as a proper strategy to improve maternal and child health and nutrition.  This is a continuous activity in which we plan to use radio as a tool for providing nutrition, and health messages to empower women in the remote or disadvantaged communities of northern Ghana. Empowerment is essentially a transition from a position of enforced powerlessness to one of power (ability to make decisions affecting oneself). One method of achieving women’s empowerment is through mass communication and propaganda. Using radio as a tool of communication is innovative, low-tech, inexpensive and culturally appropriate to citizens of northern Ghana. Community Radio (CR) plays an important role in the lives of women as it creates awareness, provides information and education, improves their skills and on the whole, it promotes social, cultural, political and economic development or empowerment of women[[28]](#footnote-28).  The need for providing nutrition education to a large segment of a diverse population using effective and efficient strategies cannot be over-emphasized. Mass media, including radio, is one way that this can be achieved but for which evidence is lacking. Scalable interventions are needed to improve infant and young child feeding (IYCF). This intervention study, therefore, seeks to evaluate whether an IYCF nutrition communication strategy using innovative drama series on the radio is associated with positive preventive health-seeking behavior and practices such as exclusive breastfeeding (BF), dietary diversity, and food consistency. | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 To engage communities via radio phone-in and radio spots to sensitize the public on the link between women’s empowerment and improved nutrition outcomes and agricultural productivity | | | | | | | | | | | | | | |
| 2.2 To empower mothers with knowledge and skills that promote appropriate infant and young child feeding practices through radio discussions | | | | | | | | | | | | | | |
| 2.3 To positively change knowledge, beliefs and attitudes of residents in communities with respect to the role of women empowerment in agricultural, nutritional and public health practices and services | | | | | | | | | | | | | | |
| 2.4 To determine the impact of radio health/nutrition education on the nutritional status of pre-school children | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research question | | | | | | | | | | | | | | |
| 3.1 Can nutrition education through the power of radio improve mothers’ knowledge and skills which in turn improve feeding practices and nutritional status of their children? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| In terms of the program design, formative research was conducted using barrier analysis to identify general feeding practices, knowledge, beliefs and attitudes with regards to recommended practices that the radio nutrition education program is based. Advocacy messages in the form of jingles, spots and drama are developed and being aired on five radio stations aimed at improving the consumption of available nutrient-rich foods and to increase nutrition-related knowledge and attitudes. The radio programme is produced and broadcast in local languages of the target population.  The first phase of the intervention runs for a period of at least 6 months in the intervention districts. In the second phase, Community Radio Listening Groups (CRLGs) involving men, women will be formed in the project communities. A community radio listening group is defined as “a group of people in a community listening regularly, together, on a fixed place, during set times, discussing targeted messages broadcast on local radio and giving feedback to producers”. Listening groups provide a sphere for sharing "knowledge and expertise”. Evidence shows that radio forums are effective and superior to the use of radio alone.  Community sensitization and formation of CRLGs in the selected communities will be followed by training of radio listening groups facilitators, the content of which will include group meetings facilitation, supervision, and monitoring. The facilitator is also trained on how to stimulate and guide discussion after a program and record meeting deliberations and feedback in special forms to be provided for this purpose.  These reports will contain information such as the group name, the date, time, and place of its meetings, the members present, the title of program and its message, comments on programs and suggestions for improvements. Feedback forms filled by facilitators are collected by the sub-district health staff who will prepare and submit quarterly reports and send copies to District Health Management Teams and UDS Project coordinator.  A two-arm, quasi-experimental, non-randomized, controlled trial pre-post design, will be used to quantify the effectiveness of a **radio listening behavior**. Two cross-sectional surveys will be conducted pre- and post-intervention. Mothers with children aged 6-18 months were surveyed at baseline and the same cohort of beneficiaries will be subjected to the end line survey. A sample size of 25 clusters will be selected from the intervention study area and another 25 clusters from the control study area. In each cluster, 12 households representing 12 study participants will be selected for the study.  Women’s empowerment will be measured using the Women’s Empowerment in Agriculture Index (WEAI) ([Alkire *et al.*, 2013](https://cgiar.sharepoint.com/sites/IITA/Projects/AfricaRising/Shared%20Documents/contracts/WA/UDS-School%20Health-2486/Amendment%205%20IITA-UDS%20PJ-1503%20AG-2486%20(3-9-19).docx#_ENREF_1))[[29]](#footnote-29). Infant and young child feeding (IYCF) practices will be measured using the maternal recall of practices related to breastfeeding and complementary feeding using eight IYCF indicators recommended by the WHO2 ([WHO, 2008](https://cgiar.sharepoint.com/sites/IITA/Projects/AfricaRising/Shared%20Documents/contracts/WA/UDS-School%20Health-2486/Amendment%205%20IITA-UDS%20PJ-1503%20AG-2486%20(3-9-19).docx#_ENREF_10))[[30]](#footnote-30).  Baseline differences between the intervention groups will be assessed using ANOVA test (for continuous variables) or Chi-square test (for categorical variables). For impact analyses, the difference-in-difference (DID) impact estimates using fixed-effects regression models that assesses differences in changes over time between the two intervention group and the control group3 ([Gertler et al., 2011](https://cgiar.sharepoint.com/sites/IITA/Projects/AfricaRising/Shared%20Documents/contracts/WA/UDS-School%20Health-2486/Amendment%205%20IITA-UDS%20PJ-1503%20AG-2486%20(3-9-19).docx#_ENREF_4)) will be applied adjusting for geographic clustering, infant age, gender and variables that will be significantly different between groups at baseline. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | |  | | | | |
| 5.1 Anthropometric data (linear growth as length-for-age Z-scores) and 24-hour dietary recall will be used for nutritional assessment.  The primary outcomes of the intervention will be linear growth as assessed by mean change in length-for-age (LAZ), women’s empowerment in agriculture and mothers’ level of knowledge and practice of recommended feeding and health practices.  **Secondary outcomes**  Secondary outcomes will include:   * Mean change (from baseline to end line) in weight and weight-for-length Z-scores (WLZ) * Proportion of children consuming foods from 4 or more food groups * Proportion of children consuming the recommended number of semi-solid/soft meals and snacks per day * Proportion of children meeting minimum acceptable diet | | | | | | | | | | Mahama Saaka/UDS | | | | |
|  | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | | | Delivery date | | |
| 6.1 25 community radio listening groups established and trained | | | | | | | Report on the training of radio listening groups | | | | | Oct. 2019 | | |
| 6.2 Baseline and follow-up surveys data | | | | | | | Report submitted and data uploaded in Dataverse | | | | | May 2020 | | |
| 6.3 Airing of women’s empowerment in agriculture advocacy and nutrition messages on 5 community radios | | | | | | | Progress reports on scheduled activities | | | | | Aug. 2019 | | |
| 6.4 The following article will be published:  The effect of radio health/nutrition education on dietary diversity, child feeding practices, maternal and child nutritional outcomes | | | | | | | Article available online | | | | | Dec. 2020 | | |
|  | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | |
| Domain | | | Indicator | | | | | Metrics/Scale | | | | | | |
| 7.1 Productivity | | | Not applicable | | | | |  | | | | | | |
| 7.2 Environmental | | | Not applicable | | | | |  | | | | | | |
| 7.3 Economic | | | Not applicable | | | | |  | | | | | | |
| 7.4 Social | | | Not applicable | | | | |  | | | | | | |
| 7.5 Human | | | Nutrition | | | | | Dietary diversity of women and children aged 6-23 months at household level | | | | | | |
| Nutritional status of children aged 6-23 months (underweight, stunting, wasting) at household level | | | | | | |
| Uptake of essential nutrients by children aged 6-23 months at household level | | | | | | |
| Capacity to experiment | | | | | Number of new practices tested by women in child-bearing age at household level | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | |
| Scaling up nutrition and agricultural interventions entails identifying those programs and practices of proven efficacy and applying management, communications, and monitoring principles and tools to expand the number of beneficiaries until everyone who requires the product or service is reached. During the process of scaling-up, given resource constraints and as a good management practice, it is often necessary to prioritize groups that have a more urgent need (in this case the most undernourished children).  The findings could provide a framework for future media training of Agriculture Extension Agents (AEAs) and Community Health Workers (CHWs) in Ghana with the involvement of the Ghana Health Service. Activities may also help boost women’s self-confidence, generate awareness about food production, child feeding practices and hygiene on a wider scale.  This activity will use the power of radio for both empowerment and scaling. Involvement of local health officials will provide sustainability to the scaling efforts even when the project is completed. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| This is a cross-cutting activity which seeks among others to promote the women’s empowerment in the utilization of farm produce through radio discussion and therefore has links with Sub-activity GH1115-and GH1116-19 which will improve the use of improved varieties and appropriate agronomic practices for increased maize and legume yields It is also linked with sub-activity GH111A-1804-3 which seeks to improve the production of dry season vegetables. And with sub-activity GH4121-19 which seeks to engage ICT and GIS tools as a means to share information. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | |
| * 15 radio listening groups trained * 2 technical reports * Anthropometric database * Article on the effect of radio health education on dietary diversity, child feeding practices, maternal and child nutritional outcomes | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Under-nutrition and its effects on human capital development such as proper child growth | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farm families as well as policymakers. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | | | **UDS** | |
| Personnel | | | | | | | | | | | | | 4,000 | |
| Services | | | | | | | | | | | | | 2,000 | |
| Supplies | | | | | | | | | | | | | 2,000 | |
| Travel | | | | | | | | | | | | | 2,500 | |
| Overhead (15%) | | | | | | | | | | | | | 1,575 | |
| **Total** | | | | | | | | | | | | | **12,075** | |

13. Gantt Chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | | | | | | |
| **Quarter** | **Quarter 4 (2018)** | | | **Quarter 3 (2019)** | | | **Quarter 4 (2019)** | | | **Quarter 1**  **(2020)** | | | **Quarter 2 (2020)** | | |
| **Month** | **10** | **11** | **12** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** |
| **Sub-activity GH2121-19** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Conduct of baseline survey and formative research |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Conduct of process evaluation of on-going nutrition education on radio |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Radio listening groups at community level |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Airing of nutrition messages on selected radio stations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Supervision of field activities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Impact evaluation of radio listening at community level |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 2: More farmers and farm families in the intervention communities are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | | |
| a. Output 2.1 | | | | Improved technologies, practices and habits to increase production and consumption of diverse and more nutritious food by farm families, especially by women and children are developed. | | | | | | | | | |
| b. Activity 2.1.2 | | | | Train farm families, especially women, to produce and consume diverse and more nutritious food. | | | | | | | | | |
| c. Sub-activity GH2122-19 | | | | Improving Child and Maternal Nutrition through Home Container Vegetable Gardening. | | | | | | | | | |
|  | | | | | | | | | | | | | |
| d. Research team | | | | |  | | | |  | | | | |
| Name | | | | | Institution | | | | Role | | | | |
| Mahama Saaka | | | | | UDS-Dept. Nutritional Sciences | | | | Sub-activity lead | | | | |
| Clement Kubuga | | | | | UDS-Dept. Nutritional Sciences | | | | Train and supervise farmer groups on the use of container vegetable gardening | | | | |
| Jean-Baptiste Tignegre | | | | | WorldVeg | | | | Nutrient-dense vegetable production in selected communities | | | | |
| Mary Paula Kogana | | | | | Women in Agric Development (WIAD) | | | | Mobilization of community interest groups (e.g. women’s groups) | | | | |
| Benedict Ebito Boyubie | | | | | IITA | | | | Develop data collection tools, train the research team on Feed the Future indicators and support in data collection to track output level and Feed the future indicators  Ensure data upload on Dataverse | | | | |
|  | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | |
| Name | | | Institute | | | | | Degree | | Start | | | End |
| NIL | | |  | | | | |  | |  | | |  |
|  | | | | | | | | | | | | | |
| f. Location(s) | 25 communities in 5 districts (Savelugu, Tolon, Wa West, Nadowli and Kassena-Nankana) of northern Ghana (This expands beyond the 12 Africa RISING communities) | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| g. Start | July 2018 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| h. End | December 2020 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | |
| In most households of Northern Ghana, there is an inadequate intake of micro-nutrients partly due to lack of access to a variety of foods, and intake of animal source foods is low. The quality of a child’s diet is a key determinant of optimal growth, development and health. Poor nutrition not only retards growth and development but also increases children’s risk of developing chronic diseases such as obesity, increased cholesterol levels and hypertension later in life (Berenson *et al*., 1998[[31]](#footnote-31); Schneider *et al*., 2007[[32]](#footnote-32); Skinner *et al.[[33]](#footnote-33)*, 2004).  Micronutrient deficiencies may be addressed by increasing the availability of, access to, and ultimately consumption of foods that are rich sources of micronutrients. A food-based approach that could help reduce micronutrient deficiencies by providing nutrient-rich foods is home gardening (Shisanya S.O., Hendriks S.H., 2011[[34]](#footnote-34); Berti P.R., Krasavec J., Fitzgerald S., 2004[[35]](#footnote-35); Holmer R.J., 2011[[36]](#footnote-36); Keatinge J.D.H. *et al*., 2011[[37]](#footnote-37)). It is further argued that vegetable gardening enables women to have greater authority over the quality of the family diet (Ruel, M.T., Levin C.E., 2001[[38]](#footnote-38)). In addition, the potential use of household wastewater for irrigation and household organic wastes for compost provides opportunities to make efficient use of limited resources and close broken nutrient cycles and this is of benefit to the environment and can represent a sustainable system.  However, poor diets and inadequate food intake are not always the result of a lack of food or money to buy food. People must have some knowledge of nutrition: the most important information is what kinds of food to eat and how to prepare the food in the right quantities and mixes and in a way that is safe and clean for children's healthy growth and development. Therefore, concurrent nutrition education and home vegetable production have a greater potential to impact positively on household nutrition.  For poor households, vegetables and fruits are often the only sources of micronutrients in the family diet. Homestead production of fruits and vegetables provides the household with direct access to important nutrients that may not be readily available or within their economic reach.  A sustainable means of producing the basic essential food such as vegetables is a requirement for preventing micronutrient deficiencies. A home garden can supply a family with substantial quantities of a variety of foods all year round and a source of family income. Home gardening, therefore, has economic and nutritional merit but which most households are not taking advantage of due to some constraints including lack land space and water availability.  Therefore, this study seeks to evaluate whether home container gardening would be a good means to improve household food and nutrition security. The intervention focuses on introducing improved (open-pollinated) nutrient-rich vegetable varieties suitable for growing in a home garden and for which seed is locally available. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | |
| 2.1 To establish home container vegetable gardens and evaluate their contribution to food and nutrition security among rural households. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | |
| 3.1 Can homestead gardening improve the dietary quality and household food security and nutrition in rural households in Northern Ghana? | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | |
| Demographic, socio-economic and home garden information will be collected during household interviews using a structured questionnaire.  Household food intake will be assessed by using a semi-quantitative method based on recall of foods consumed by the household during the 24 hours preceding of the survey from the household member who prepared the previous day’s meals.  The meain independent variable will be the production and consumption of nutrient-dense foods.  Household food security will be assessed by using food consumption core (FCS) and individual and household dietary diversity. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | | |  | | |
| 5.1 Study data (Baseline and endline survey) | | | | | | | | | | | Mahama Saaka/UDS | | |
| 5.2 Monitoring data (Vegetable production figures and established number of vegetable gardens) | | | | | | | | | | | Jean-Baptiste Tignegre/WorldVeg | | |
|  | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | Delivery date | | |
| 6.1 Functioning and productive gardens | | | | | | Physical existence of functioning community gardens | | | | | Mar. 2020 | | |
| 6.2 Nutrition education to targeted households | | | | | | Technical report of intervention | | | | | May 2020 | | |
| 6.3 An article on Effect of joint nutrition education and homestead vegetable production on empowerment of women and household food security | | | | | | Article available online | | | | | Dec. 2020 | | |
|  | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | Metrics/ scale | | | | | | |
| 7.1 Productivity | | Not applicable | | | | |  | | | | | | |
| 7.2 Environmental | | Not applicable | | | | |  | | | | | | |
| 7.3 Economic | | Not applicable | | | | |  | | | | | | |
| 7.4 Social | | Not applicable | | | | |  | | | | | | |
| 7.5 Human | | Nutrition | | | | | Dietary diversity of women of childbearing age at household level | | | | | | |
|  | |
| Uptake of essential nutrients by children aged 6-23 month at household level | | | | | | |
| Nutritional status (stunting, wasting and underweight) of children under 5 years at household level | | | | | | |
| Capacity to experiment | | | | | Number of new practices tested by women of childbearing age | | | | | | |
|  | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | |
| Scaling up nutrition and agricultural interventions entails identifying those programs and practices of proven efficacy and applying management, communications, and monitoring principles and tools to expand the number of beneficiaries until everyone who requires the product or service is reached. During the process of scaling-up, it is often necessary to prioritize groups that have a more urgent need (in this case the most undernourished children). The main platforms through which nutrition interventions can be scaled up are health systems (where the government is usually in the lead and the private sector also has a role) and food systems (where the private sector is most active, but the government has an important role to play). | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | |
| This activity has close links to Sub-activity GH1115-19 which will Identify varieties of vegetable crop species with adaptation to Northern Ghana in the dry season, Sub-activity GH1116-19 which seeks to improve the capacity of vegetable farmers on vegetable gardening and post-harvest techniques. Targeting of nutrition-specific interventions will primarily be based on the vulnerability of households to food insecurity and high prevalence of undernutrition*.* Activities will be implemented in line with the Africa RISING overall strategic partnerships and geographical targeting ensuring convergence of nutrition interventions with other interventions and stakeholder activities (including livestock and crops) to focus on the same locations with complementary services in order to increase the impact of each other’s’ actions. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | |
| * Number of farmers trained in home gardening at household level * Number of households that have successfully adopted container home gardening technology * Income from the sale of garden produce * Micronutrient adequacy ratio of selected essential nutrients * Vegetable production expressed in kilograms per household member per year | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing? Under-nutrition effects on human capital resource | | | | | | | | | | | | | |
| 11.2 Who is your target audience? e.g. extension agents, farmers, or policymakers: Farm families | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | |
| **Budget line item item** | | | | | | | | | | | | **UDS** | |
| Personnel | | | | | | | | | | | | 8,000 | |
| Services | | | | | | | | | | | | 6,000 | |
| Supplies | | | | | | | | | | | | 4,500 | |
| Travel | | | | | | | | | | | | 4,500 | |
| Overhead (15%) | | | | | | | | | | | | 3,450 | |
| **Total** | | | | | | | | | | | | **26,450** | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Quarter** | **Quarter 4 (2018)** | | | **Quarter 3 (2019)** | | | **Quarter 4 (2019)** | | | **Quarter 1**  **(2020)** | | | **Quarter 2 (2020)** | | |
| **Month** | **10** | **11** | **12** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** |
| **Sub-activity GH2122-19** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mobilization of community interest groups (e.g. women’s groups) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Train and supervise farmer groups on the use of container vegetable gardening |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Baseline data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Supervision of field activities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Impact evaluation of intervention |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 2: More farmers and farm families in the intervention communities are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | |
| a. Output 2.1 | | | | Improved technologies, practices and habits to increase production and consumption of diverse and more nutritious food by farm families, especially by women and children are developed. | | | | | | | | |
| b. Activity 2.1.2 | | | | Train farm families, especially women, to produce and consume diverse and more nutritious food. | | | | | | | | |
| c. Sub-activity GH2123-19 | | | | Engaging Men to Increase Support for Optimal Child Feeding Practices Using Care Group Approach/Model. | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | | |
| Mahama Saaka | | | UDS- Community Nutrition | | | Sub-activity leader | | | | | | |
| Chrisantus Daari | | | Ghana Health Service | | | Assists with training of men’s groups, data collection and compilation of monthly reports on activities | | | | | | |
| Kofi Evam Glover | | | UDS- Community Health Dept. | | | Social scientist to assist with the conduct of a qualitative formative study on gender issues on nutrition at community level | | | | | | |
| Lawal Alhassan | | | Ghana Health Service | | | Assists with training of men’s groups, data collection and compilation of monthly reports on activities | | | | | | |
| Khadija Wemah | | | Ghana Health Service | | | Monitors subdistrict field activities including delivery of nutrition education, men’s group meetings and home visits | | | | | | |
| Benedict Ebito Boyubie | | | IITA | | | Develop data collection tools, train research team on Feed the Future indicators and support in data collection to track output level and Feed the Future indicators  Ensure data upload on Dataverse | | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | Institute | | | | Degree | | | | | Start | End | |
| Sulley Issahaku | UDS, Dept. Nutritional Sciences | | | | MPhil (Public Health and Nutrition) | | | | | August 2018 | December 2020 | |
|  | | | | | | | | | | | | |
| f. Location(s) | 25 communities in 5 districts (Savelugu, Tolon, Wa West, Nadowli and Kassena-Nankana) of northern Ghana (This expands beyond the 12 Africa RISING communities | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | July 2018 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | April 2020 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| Over the years, mothers have been the focus of nutrition education and this has led to a better understanding of nutrition issues among women than their male counterparts. In practice, when it comes to decision making regarding improving optimal feeding of children, the support of men cannot be over-emphasized. In Ghana, most community programs seeking to improve the well-being of women and children target mothers and their children with little attention to fathers as key influencers. There is great potential for fathers to make a difference in the rate of the infant feeding practices, but they need information in order to make a difference (Kenosi *et al*., 2011)[[39]](#footnote-39) (Tohotoa *et al*., 2009)[[40]](#footnote-40). Engagement of fathers by educating them on infant and young child nutrition including breastfeeding through men’s group activities may greatly improve infant feeding and health behavior (Sloand *et al.*, 2009)[[41]](#footnote-41) (Matovu *et al*., 2008)[[42]](#footnote-42) because they play a critical role in providing instrumental and emotional support to mothers and children. Interventions that involve men as agents of positive change in support their partners to adequately feed their families may greatly improve infant feeding and health behavior (Sloand *et al.*, 2009)19 but the evidence is lacking in Ghana and therefore warrants more research in this area. This intervention seeks to assess whether men’s engagement in nutrition education at the community levelis effective to improve child feeding practices/child nutrition. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 To assess men’s willingness to be engaged in discussing and promoting infant feeding in Northern Ghana | | | | | | | | | | | | |
| 2.2 To determine the influence and effect of fathers’ participation in nutrition education sessions on child feeding practices and on the nutritional status of their children under three years | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 Can men engagement in nutrition education at the community levelimprove child feeding practices and child nutrition? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| A cluster non-randomized-controlled trial will be used to assess the effectiveness of engaging men in nutrition education on child feeding practices and nutritional status of children. This will entail carrying out pre-post cross-sectional surveys. The sample size will be calculated that will be adequate with 80 % power to detect an effect size of 20 % at 95 % confidence level. Households with men participating in community nutrition education activities will constitute the intervention group whilst the comparison group will comprise households not involving men in such activities. At the cluster level, a sample size of 15 households with a male partner/caretaker and children under three years of age will be systematically selected across the 25 Africa RISING intervention communities. A difference-in-differences analysis will be used to calculate intervention effects. Adjusted odds ratios (AORs) and 95% confidence intervals (95% CI) of associated factors with the key outcome measures will also be estimated. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | Responsibility/Institute | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | |  | | | |
| 5.1 Study data (Baseline and end-line survey) | | | | | | | | | Mahama Saaka/UDS | | | |
| 5.2 Monitoring data (Care group on-going functionality data) | | | | | | | | | Mahama Saaka/UDS | | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | | | Delivery date |
| 6.1 Formation and utilization of Men’s Support Groups (MSG) for the delivery of health and nutrition messages in 25 intervention communities | | | | | | | | Impact Evaluation report of intervention | | | | Sep. 2020 |
| 6.2 A paper on Using men engagement in nutrition educationto improve child feeding practices/nutrition | | | | | | | | Online publication | | | | Dec. 2020 |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | |
| Domain | | Indicator | | | | | Metrics/Scale | | | | | |
| 7.1 Productivity | | Not applicable | | | | |  | | | | | |
| 7.2 Environmental | | Not applicable | | | | |  | | | | | |
| 7.3 Economic | | Not applicable | | | | |  | | | | | |
| 7.4 Social | | Not applicable | | | | |  | | | | | |
| 7.5 Human | | Nutrition | | | | | Dietary diversity of women of childbearing age at household level | | | | | |
|  | |
| Uptake of essential nutrients by children aged 6-23 month at household level | | | | | |
| Nutritional status (stunting, wasting and underweight) of children under 5 years at household level | | | | | |
| Capacity to experiment | | | | | Number of new practices tested by women of childbearing age | | | | | |
|  | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | |
| The intervention will be carried out in strong collaboration with Ghana Health Service staff who will be in a position to extend the activities to other communities where they operate. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | |
| Activities will be implemented in line with the Africa RISING overall strategic partnerships and geographical targeting ensuring convergence of nutrition interventions with other interventions and stakeholder activities that seek to deliver useful messages to community groups, e.g. Sub-activity GH4121-19 which seeks to engage ICT and GIS tools as a means to share information on agriculture and nutrition. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | |
| * Levels of male involvement in infant and young child nutrition * A published paper on the impact of the engagement of men on infant and young child nutrition education and nutrition practices | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Under-nutrition effects on human capital resources. | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farm families. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | | **UDS** |
| Personnel | | | | | | | | | | | | 4,000 |
| Services | | | | | | | | | | | | 2,000 |
| Supplies | | | | | | | | | | | | 2,500 |
| Travel | | | | | | | | | | | | 3,200 |
| Overhead (15%) | | | | | | | | | | | | 1,755 |
| **Total** | | | | | | | | | | | | **13,455** |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Quarter** | **Quarter 4 (2018)** | | | **Quarter 3 (2019)** | | | **Quarter 4 (2019)** | | | **Quarter 1**  **(2020)** | | | **Quarter 2 (2020)** | | |
| **Month** | **10** | **11** | **12** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** |
| **Sub-activity GH2123-19** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Formation of men’s groups |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Baseline data collection (formative research) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training of men’s groups |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Monthly nutrition education in men’s groups |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Supervision of field activities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Community durbars and special fathers’ days |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Impact evaluation of intervention |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 2: More farmers and farm families are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | |
| a. Output 2.2 | | | | Postharvest technologies and practices to provide options for the food and feed sectors are tested and disseminated to farmers, through researchers, extension staff, and development partners. | | | | | | | | |
| b. Activity 2.2.1 | | | | Introduce, evaluate, adapt and disseminate existing postharvest technologies and practices. | | | | | | | | |
| c. Sub-activity GH2211-19 | | | | Evaluate the threshing efficiency of different maize shellers with regards to grain quality characteristics as influenced by different varieties and harvest timing. | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | | Institution | | Role | | | | | | |
| Issah Sugri | | | | CSIR-SARI | | Lead Investigator and coordinates all activities | | | | | | |
| Mutari Abubakari | | | | CSIR-SARI | | Team Member and contributes to data collection | | | | | | |
| Robert K. Owusu | | | | CSIR-SARI | | Data collection and analysis | | | | | | |
| Kotu Bekele | | | | IITA | | Socio-economic analysis | | | | | | |
| Abdul-Rahman Nurudeen | | | | IITA | | Team member offers agronomic support | | | | | | |
| Benedict Boyubie | | | | IITA | | FtF indicators and ensure data upload on Dataverse | | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | Institute | | | | | Degree | | Start | | | End |
| Nil | |  | | | | |  | |  | | |  |
|  | | | | | | | | | | | | |
| f. Location(s) | Northern, Upper East and Upper West | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | June 2019 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | June 2020 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| **Statement of the problem**  In most parts of Ghana, postharvest operations in maize (harvesting, threshing, shelling and cleaning) are done manually by hand, and oftentimes by women. This is associated with drudgery and high losses, which can be immensely reduced by mechanizing such operations. Traditional shelling methods need to be improved to accommodate recent developments such as the emergence of medium to large-scale farmers where mechanized shelling becomes inevitable. In addition to cost, one other challenge is that some mechanical shellers can cause high damage to the grain if adequate precautions are not taken. Threshing efficiency generally is related to the variety, grain moisture content, operations efficiency of machine and human expertise.  Therefore, manipulation of design considerations and grain moisture relations are necessary for optimizing threshing efficiency. Ideal harvest time (timing and maturity) is a key factor that contributes to obtaining high-quality grain and reducing threshing losses. Whereas harvesting too early may result in immature grain, on the other hand, delayed harvest can increase the potential damages from insects, excess rains, lodging and microbial attack that may accelerate the quality deterioration in the postharvest phase.  The release of extra-early maturing varieties and climate variability require improvements in harvesting, threshing and drying operations. Poor drying and threshing operations have an influence on grain quality and aflatoxins contamination. Best harvest and threshing operations are hence expected to improve grain quality and reduce part of handling losses. Therefore, information on the ideal harvest time (IHT) is necessary to ensure maximum grain quality. Morphological and physiological changes that occur during the maturation process have been used as parameters to identify ideal harvest time in maize. These include calendar days, leaf-fall, black layer formation, milk-line development, seed weight and seed moisture content. However, some variation among genotypes and environmental conditions at harvest may exist. | | | | | | | | | | | | |
| 2. Objectives: The study seeks to reduce postharvest losses by evaluating and promoting the use of improved, simple and efficient maize shellers for smallholders | | | | | | | | | | | | |
| 2.1 To evaluate the operational and economic efficiencies of different maize shellers which are appropriate for small and medium-scale growers | | | | | | | | | | | | |
| 2.2 To evaluate the effects of variety, harvest timing and grain moisture on grain quality characteristics after threshing with different shellers | | | | | | | | | | | | |
| 2.3 To train beneficiary farmers on the operation and economic benefits of mechanical shellers | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 Time, labor, drudgery and threshing losses can be significantly managed by adopting simple threshing machine. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| **Treatments**  Three maize varieties (Obantampa, Abontem and Omankwa) will be planted and harvested at maturity intervals of 1, 2, 3 and 4 weeks starting from harvest maturity. Threshing will be done using three options (Control/manual, Diesel-powered medium sheller and commercial PTO sheller). A simple harvest which farmers can follow without complex equipment will be used. The harvest index scale 1: Cob is dry but most of the leaves above cob are green; 2: Cob is dry, but 3-4 leaves above cob are green; 3: Cob is dry, but last 1-2 leaves are green; 4: Cob is dry, and the entire plant is dried.    The throughput capacity (kg/h) and mechanical eﬃciency will be determined using the equation below. At each harvest interval, 100 kg of unthreshed maize will be measured using a weighing scale. Cost of human energy (assessed as man-hours) and time required to load the cobs into the hopper and the time to ﬁnishing threshing operations will be determined. Threshing efficiency will be determined in terms of threshing time, the total weight of whole grain, broken grain and spillage will be determined. The percentage of mechanical damage and machine performance index will be assessed and compared.  The throughput capacity (TPC) kg/h:  Where: Tw is the total weight of unthreshed material, and Tt is the total time taken in handling the materials.  Moisture characteristics associated with these periods will be characterized and modelled for decision making. Participatory demonstration sessions and training will be conducted for farmers at the harvest maturity period. Training sessions will consist of 2-hours of technical information, and 2-hours of hands-on operation of the machines. The growers will be linked to suppliers and manufacturers. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | | |  | | |
| 5.1 Archive of improved varieties and moisture relations | | | | | | | | | | Sugri/SARI | | |
| 5.2 Technical notes on best harvest and postharvest practices | | | | | | | | | | Sugri/SARI | | |
| 5.3 Training materials on use of improved shellers | | | | | | | | | | Sugri &  Abubakari/SARI | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | Means of verification | | | | | Delivery date | | |
| 6.1 Synthesis summary of characterized improved varieties and moisture relations for threshing efficiency and storage | | | | | Semi-Annual Project reports | | | | | Jun. 2020 | | |
| 6.2 Farmer field days on best harvest and postharvest practices | | | | | Semi-Annual Project reports | | | | | Jun. 2020 | | |
| 6.4 Feedback Report on farmer capacity building from training and demonstrations on the use of improved shellers | | | | | Semi-Annual Project report | | | | | Jun. 2020 | | |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | |
| Domain | | | Indicator | | | | | Metrics/Scale | | | | |
| 7.1 Productivity | | | Reduction in food losses | | | | | Yield (kg/ha/season) at farm level | | | | |
| 7.2 Economic | | | Labour cost, food availability | | | | | Labor requirement (hours/ha) at farm level through direct observations and farmer evaluations | | | | |
| 7.3 Social | | | Social cohesion | | | | | Participation in social groups at the community level | | | | |
| 7.4 Human | | | Increase household food security | | | | | Food production (Calories/ha/year) through participatory assessments | | | | |
|  | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | |
| The study will be conducted in the AR-Project technology park at Bonia. Through farm visits and farmer field days, the participants will be schooled on harvest indices, drying, threshing and storage of maize. 150 farmers from selected communities are expected to participate. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | |
| This activity directly links to Activity led by IITA entitled “Monitoring group dynamics among users of small-scale maize shelling machines in Northern Ghana”. This sub-component serves as an enabler to ensure that the machines being promoted are functioning efficiently and conditions around their use are well known e.g. time of harvesting and moisture content as well as differences in performance of different maize varieties. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | |
| * Technical leaflets and reports | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Postharvest technologies play a role in stabilizing food supply as well as reducing wide seasonal prices. Integrated strategies to minimize postharvest losses can lead to improvement in household food and nutrition security and subsequent economic growth. | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The primary beneficiaries include farmers (both crop and livestock), traders, extension agents. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | **CSIR-SARI** | |
| Personnel | | | | | | | | | | | 2,000 | |
| Services | | | | | | | | | | |  | |
| Supplies | | | | | | | | | | | 2,000 | |
| Capital | | | | | | | | | | |  | |
| Travel | | | | | | | | | | | 3,500 | |
| Overhead (15%) | | | | | | | | | | | 1,125 | |
| **Total** | | | | | | | | | | | **8,625** | |

13. Gantt chart

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | **2020** | | | | | |
| **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** |
| Planning meeting by team |  |  |  |  |  |  |  |  |  |
| Harvest timing surveys |  |  |  |  |  |  |  |  |  |
| Focus Group Discussions in all AR Communities |  |  |  |  |  |  |  |  |  |
| Farmer trainings on use of improved maize shellers |  |  |  |  |  |  |  |  |  |
| Analysis of Data |  |  |  |  |  |  |  |  |  |
| Write Reports |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 2: More farmers and farm families are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | | | | |
| a. Output 2.2 | | | | | Postharvest technologies and practices to provide options for the food and feed sectors are tested and disseminated to farmers, through researchers, extension staff, and development partners. | | | | | | | | | | |
| b. Activity 2.2.1 | | | | | Introduce, evaluate, adapt and disseminate existing postharvest technologies and practices. | | | | | | | | | | |
| c. Sub-activity GH2212-19 | | | | | Monitoring group dynamics among users of small-scale maize shelling machines in Northern Ghana. | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | |
| Name | | | | Institution | | Role | | | | | | | | | |
| Bekele Kotu | | | | IITA | | Agricultural economist, activity leader, economic and institutional analysis | | | | | | | | | |
| Gundula Fischer | | | | IITA | | Social scientist, assessment of social dimension | | | | | | | | | |
| Mirja Michalscheck | | | | WUR | | Agricultural systems expert, typologies and power relations | | | | | | | | | |
| Abdul Rahman Nurudeen | | | | IITA | | Agronomist, assessment of productivity dimension | | | | | | | | | |
| Abdulai Adams | | | | CSIR-STEPRI | | Agricultural economist and Policy analyst, policy analysis | | | | | | | | | |
| Fred Kizito | | | | IITA | | NRM scientist, assessment of environmental dimension | | | | | | | | | |
| Benedict Boyubie | | | | IITA | | FtF indicators and ensure data upload on Dataverse | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | |
| Name | | Institute | | | | Degree | | | | Start | | | | End | |
| NIL | |  | | | |  | | | |  | | | |  | |
|  | | | | | | | | | | | | | | | |
| f. Location(s) | Northern Region, Upper West Region, Upper East Region | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| g. Start | October 2019 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| h. End | June 2021 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | |
| Mechanization is an important complement, and in some cases, a necessary condition, to agricultural intensification. It constitutes several implements and machines which can substitute or supplement human labor to carry out energy/power-intensive operations (such as land preparation, harvesting and threshing) as well as control intensive operations (such as planting and weeding) (Pingali, 2007[[43]](#footnote-43)). While agricultural mechanization importantly reinforced the productivity gains of the Asian green revolution, current scholarly opinions indicate that mechanization may even play a larger role to intensify African agriculture due to the high land-to-labor ratio in many African countries such as Ghana, Tanzania, Nigeria, Senegal, and Zambia (Nin-Pratt and McBride, 2014[[44]](#footnote-44)). That is when existing land has to be more intensively cultivated, mechanization will be adopted to complement the higher labor demand to accomplish increased activities. Secondly, there are also arguments that agricultural operations are arduous by their nature and mechanization is necessary to reduce the drudgery.  Drudgery has increasingly become important to explain the opportunity cost of labor, particularly for the youth, who can otherwise be engaged in less laborious urban-based employment although they may be less productive (Mrema *et al*., 2008[[45]](#footnote-45)). Most of the laborious activities such as manual threshing are usually carried out by women and hence the adoption of mechanization may improve the welfare of women. Thirdly, the adoption of mechanization can also reduce harvest and postharvest grain losses. For instance, a study indicates that the use of a combine harvester reduced grain losses by 20-35 percent as compared to manual threshing (Hassena *et a*l., 2000[[46]](#footnote-46)).  In view of these advantages, in phase 1, the Africa RISING research team introduced two types of small-scale maize shelling machines, one diesel operated and the other one electrically operated. We assessed the economic benefits of the two types and found that both increase labor efficiency among smallholder farmers while saving costs. Farmers can save up to 36 hours per ton of maize shelled if they use the shelling machines.  Based on these results, the machines were demonstrated to a large number of farmers (N = 1,054) in December 2018. Farmers expressed great interest in using the machines. They preferred the diesel-powered machine to the electric machine because of its better design (i.e. wider conveyor system that can take many cobs at a time) and its higher efficiency. To facilitate scaling and technology transfer towards empowering smallholder farmers, Africa RISING will facilitate the transfer of the diesel-powered maize shelling machines to groups of farmers who fulfill the eligibility criteria set by the project. The eligibility criteria include that the groups should craft their own constitution and they should contribute about 25% of the machines estimated market value. Another eligibility criterion will be gender balance in leadership – a point to be stipulated in the constitutions. The groups will be linked to local artisans who may provide professional support such as maintenance, adaptation and repair services if the need arises. We will consider the technology transfer to be successful if the maize sheller machines remain in frequent use by the community members and that the community members themselves consider the user agreement and its effectuation as fair.  For the economic domain, we hypothesize that the utility (benefits) that farmers get from the maize shelling machine and the performance of the machine are influenced by the quality of their constitution and its implementation (i.e. its validity, comprehensiveness, and flexibility (collective choice and operational rules) applied regarding the use of the machines) while the performance of the constitution will be influenced by the perceptions that the farmers have on the benefits of the machine. Apart from the utility in the economic domain, the social analysis will examine the cultural norms and socio-economic institutions that manifest themselves in group dynamics and constitutions. These may increase benefits for some community or group members and limit access to mechanization for others. Social dynamics may revolve around a variety of stratifying criteria (gender, age, education, migrant versus native status, etc.). | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | |
| 2.1 To assess and describe the dynamics and the rules of engagement among group members, non-group members, and other stakeholders with whom they are interacting to make use of the maize sheller | | | | | | | | | | | | | | | |
| 2.2 To compare and contrast different user groups (with their particular composition of farm and farmer types) to determine which groups have been most successful in mechanization and why | | | | | | | | | | | | | | | |
| 2.3 To reveal factors that hindered a successful implementation so that future user agreements may be shaped to avoid these hampering factors | | | | | | | | | | | | | | | |
| 2.4 To examine how factors such as grain moisture content and machine use efficiency affect the quality of maize grains shelled | | | | | | | | | | | | | | | |
| 2.5 To investigate the extent to which mechanization is promoted and implemented in agricultural development ordinances and policies in Ghana at various levels ranging from the community level, district level and national level | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 3. Research questions  Main research question: How can the user agreements best contribute to full and fair utilization of the maize shellers at the community level? | | | | | | | | | | | | | | | |
| 3.1 Do the user groups show differences among themselves in terms of the rules and norms, which govern the use and management of the machines? And if yes: describe these differences (including those related to the gender composition of group members and leadership). | | | | | | | | | | | | | | | |
| 3.2 Do the groups show differences among themselves in terms of success/failure (measured vis-a-vis the sustainable intensification assessment domains)? | | | | | | | | | | | | | | | |
| 3.3 What are the sources of success/failure and how do these sources contribute to the success/failure of the group in the process of mechanization? | | | | | | | | | | | | | | | |
| 3.4 How does the usage of the maize shellers by the different group of farmers affect the quantity and quality of maize grains? | | | | | | | | | | | | | | | |
| 3.5 What are the enabling policy strategies or ordinances and bylaws on agriculture mechanization, and to what extent have they been implemented at the district and farm household levels? | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, sex disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | | |
| 4.1 Systematic comparison of written constitutions followed by a collection of narratives on (1) the actual implementation of the constitution as well as (2) ongoing group dynamics. Group dynamics will further be explored by determining individual / sub-group-interests as well as their power shares (quantified) using the stick-score method described in Michalscheck (2019).  4.2 The success or failure of a group will be measured by collecting narratives that allow a comparison between ‘group objectives’ as defined in the constitution and actual ‘group-level outcomes. We also compare the group’s objectives and outcomes with the ‘expectations’ (increase in mechanization --> productivity/less labor) by Africa RISING.  4.3 For each case study (N=X), by means of semi-structured individual interviews and focus group discussions, we explore factors that led to the success or the failure of the communal maize sheller use. We then compare these factors among the intervention sites to determine common patterns and ‘the main lessons learnt’ in order to provide clear advice for the institutional set-up of the communal ownership of agricultural machinery, using the example of the maize sheller. We will furthermore engage with partners and other research for development projects to share the lessons learnt and eventually to add their experience to our assessment, too.  4.4 Selected policy documents on agricultural development, annual development plans and reviews will be reviewed, and relevant stakeholders in the formulation and implementation of policies interviewed.  In summary: the study mainly uses qualitative data. Data will be collected through periodic qualitative interviews with group members, non-group members, artisans and other stakeholders. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | |  | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | | Responsibility/Institute | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | | | |  | | | |
| 5.1 Systematic comparison of user constitutions as well as qualitative descriptions of their actual implementation. | | | | | | | | | | | | Bekele Kotu/IITA | | | |
| 5.2 A qualitative/quantitative description of the success or failure of the maize sheller use based on the user agreements (for different farm and farmer types). | | | | | | | | | | | | Bekele Kotu/IITA,  Mirja Michalscheck/WUR | | | |
| 5.3 Quantity of shelled maize grains, % maize grain breakages and grain moisture content | | | | | | | | | | | | Abdul-Rahman Nurudeen/IITA | | | |
| 5.4 Quantity of fuel used and qualitative data on environmental aspects. | | | | | | | | | | | | Fred Kizito/IITA | | | |
| 5.5 A qualitative description of user groups in terms of gender. | | | | | | | | | | | | Gundula Fischer/IITA | | | |
| 5.6 A qualitative description of historical and current policy on mechanization in Ghana. | | | | | | | | | | | | Abdulai Adams/STEPRI | | | |
|  | | | | | | | | | | | |  | | | |
| 6. Milestones | | | | | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | | | | Delivery date | | |
| A report that (1) describes and compares the user constitutions, as well as their actual implementation, (2), describes the success or failure of the communal ownership and use of the maize shellers and that (3) describes the reasons for success or failure, allowing recommendations for future communal user agreements.  A poster or presentation on an international conference like the Tropentag or the Farming Systems Design conference. | | | | | | | | Technical report shared | | | | | Apr. 2020 | | |
| 6.1 Quantitative data: data on broken grains, group revenues, group costs, etc. | | | | | | | | Dataverse | | | | | Sep. 2020 | | |
| 6.2 Qualitative data: anonymized and redacted transcriptions. | | | | | | | | Dataverse | | | | | Jun. 2020 | | |
| 6.3 Article submitted to a journal.  (on institutional analysis of group-based maize shelling mechanization). | | | | | | | |  | | | | | Sep. 2020 | | |
|  | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | | |
| Domain | | | Indicator | | | | | | Metrics/Scale | | | | | | |
| 7.1 Productivity | | | Quantity of shelled maize | | | | | | * kg/person/hour, household level * % of grain breakage, household level | | | | | | |
| 7.2 Environmental | | | Quantity of diesel consumed | | | | | | * liter/ton of maize shelled, household level | | | | | | |
| 7.3 Economic | | | Income, cost, profit | | | | | | * Ghana Cedi, group level | | | | | | |
| 7.4 Social | | | Social cohesion (collective action) | | | | | | * No metrics (qualitative enquiry) | | | | | | |
| 7.5 Human | | | Capacity to innovate (if groups implemented a self-initiated solution to problems created in the process of using the machine). | | | | | | * No metrics (qualitative enquiry) | | | | | | |
|  | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | |
| The findings of our study will (1) enable Africa RISING and our partners (in Ghana and beyond) to foster the use of maize shellers and other agricultural machinery through institutional support/best-practice-guidelines for drafting effective user constitutions. (2) Results of this study will be presented at workshops and conferences to share our experience with anyone engaged in the mechanization of smallholder farming. (3) We have been approached by the Soybean Innovation Lab (SIL) seeking to learn how they can potentially mimic a similar approach around technology transfer mechanisms, SIL reaches thousands of farmers and this will be an opportunity to Africa RISING approaches to touch or influence similar donor initiatives potentially impacting smallholder farmers. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | |
| This study is linked to earlier and current works of the Africa RISING research team on farmers’ typologies in Northern Ghana, forage choppers in Tanzania, and policy and institutional analysis and will also draw on lessons learnt from the aforementioned works. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | |
| * Published papers in peer-reviewed journals and conference presentations | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Most smallholder farmers in northern Ghana do not have access to mechanized maize shelling despite the presence of rental services. The reason is that rental service providers do not consider smallholders as economically feasible customers to provide door-to-door services. Thus, maize shelling is undertaken mainly using the manual method among such farmers. The manual method takes much of the farmers’ time which otherwise could have been used for other activities. Moreover, the manual method is arduous which many farmers would like to avoid. Therefore, this study will provide useful evidence on a new business model, i.e. the group model, to improve the access of smallholder farmers to shelling mechanization thereby improving labor productivity and farmers’ welfare. | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  This study mainly targets smallholder farmers in Africa RISING intervention areas. Moreover, the findings of the study can be useful to various stakeholders such as government extension agents, NGOs, and policymakers to enhance the mechanization of maize shelling and beyond. Furthermore, it will help the private sector (machine importers, local artisans, fabricators, etc.) to benefit from the mechanization of smallholder agriculture. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | **IITA** | | | | **CSIR-STEPRI** | | | | **WUR** |
| Personnel | | | | | | | 4,000 | | | | 1,500 | | | | 9,346 |
| Services | | | | | | | 1,000 | | | | 500 | | | |  |
| Supplies | | | | | | | 2,000 | | | |  | | | |  |
| Capital | | | | | | | 1,000 | | | |  | | | |  |
| Travel | | | | | | | 2000 | | | |  | | | |  |
| Overhead | | | | | | |  | | | |  | | | |  |
| **Total** | | | | | | | **10,0001** | | | | **2,0001** | | | | **9,3461,2** |
| **Grand total** | | | | | | |  | | | |  | | | | **21,346** |

1This budget is for 2019/2020 fiscal year only

2This budget includes 15% administration overhead cost

13.Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | **2021** | | | | | | | | | |
| **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** |
| Starting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection (grain breakage) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection, socioeconomic |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection (grain breakage) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection, socioeconomic |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data organization and analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Drafting paper |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Revising paper and submission to journal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ending |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 3: Outcome 3: Farmers and other value chain actors have greater and equitable access to production assets and markets (input and output) through enabling institutions and policies. | | | | | | | | | | | | | | |
| a. Output 3.1 | | | | | Improved policies and institutional arrangements to increase participation of farm families, especially women and youth in the output and input markets and decision-making are developed. | | | | | | | | | |
| b. Activity 3.1.1 | | | | | Identify constraints to and opportunities for improving access to the output and input markets by women and youth in the target area. | | | | | | | | | |
| c. Sub-activity GH3111-19 | | | | | Strengthen the technical, managerial and organizational capacities of the major actors in the small ruminant value chain through existent institutional structures such as Farmer-Based Organizations (FBOs), District Assemblies (DAs), Community Based Organizations, Traders Associations, Transporters and Input Dealers Association. | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | | | | Institution | | | | Role | | | | | | |
| Augustine Ayantunde | | | | ILRI | | | | Coordination of sub-activity, provision of supervision and general control on the project as well as technical backstopping, data analysis and final reporting | | | | | | |
| Franklin K. Avornyo | | | | ARI | | | | Coordination of training of farmers, of the functioning of Research for Development Platforms, of data collection and the report of the training | | | | | | |
| Mohammed T. Shaibu | | | | ARI | | | | Design all field instruments and lead in the data collection | | | | | | |
| Sadat Salifu | | | | ARI | | | | Assist in the collection of data | | | | | | |
| Emmanuel Panyan | | | | ARI | | | | Assist in feed resource management, availability and accessibility | | | | | | |
| The District Director | | | | Department of the Ministry of Agriculture (DoA) | | | | Help link the various actors and increase their access to technologies and information | | | | | | |
| Benedict Boyubie | | | | IITA | | | | FtF indicators and ensure data upload on Dataverse | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | |
| Name | | Institute | | | | Degree | | | | Start | | End | | |
| NIL | |  | | | |  | | | |  | |  | | |
|  | | | | | | | | | | | | | | |
| f. Location(s) | 1. Upper East Region: Kassena Nankana Municipal and Kassena Nankana West  2. Upper West Region: Wa East and Wa West | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start | August 2019 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End | March 2020 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Demand for small ruminant products is high in the whole of Ghana and beyond. Ghana is a meat-deficit country and a net importer of livestock products. Despite the level of importation, meat consumption in Ghana is still far below FAO recommended level as the average Ghanaian consumes only 9 kg meat per annum, and up to 5% of Ghanaians are chronically under-nourished with respect to protein intake. Besides meeting the domestic demand for meat, there is the added opportunity of producing for the international market. Therefore, there is a huge market base for small ruminant production in Ghana. Increased growth in the value chain of the small ruminant subsector would provide several jobs along the chain for youth and women who have been the most vulnerable in society. Fortunately, technologies that can help increase small ruminant productivity are available.  There are many important issues that relate to aspects that fall outside the purview of the existing institutional structures which constitute a major lapse in the livestock sector development effort. These include inadequate linkages with relevant agencies and bodies to enhance livestock development, low awareness of livestock stakeholders on many issues and opportunities geared towards livestock development, low advocacy for livestock development and low involvement of stakeholders in program implementation and monitoring for effectiveness.  To obtain a more favorable balance of power, farmers must be assisted to organize themselves. This class of institutions, e.g. producer cooperatives and other membership organizations are vital for the improvement of smallholders’ market access. These mechanisms offer the advantage of lowering production and transaction costs through economies of scale for logistics, distribution and marketing while improving profitability through enhanced bargaining power in both upstream and downstream markets. Efforts should be directed at transforming the functional organization of smallholder small ruminant farmers into more commercially minded groups with the ability for bulk production to supply the major markets in the country with small ruminants, particularly at festive occasions. These farmers should be linked to viable innovation/ multi-stakeholder platforms, markets, inputs suppliers, retailers and micro-financial institutions and facilitated to adopt innovations/technologies. Early adopters, committed farmers, positive deviants, literate farmers, champion farmers and “not-so-poor” farmers should be targeted to spur growth that can then benefit the poor, particularly through the multiplier effects generated by the sector development.  There are a few small ruminant actors including positive deviants who are already engaged in small ruminant fattening as a business for profit. In fact, it has been estimated that about 27% of livestock keepers in the rural sector are estimated to have profit motives. These actors can be organized to become major suppliers of small ruminants for the livestock market. Existing groups, multi-stakeholder platforms, Innovation platforms and livestock associations can be empowered for effective networking and development of the small ruminant subsector. Producers are faced with credit constraints, poor access to improved stock, feed problems, inadequate watering facilities and inefficient disease control. Controlling theft in the livestock industry is also very important. Therefore, this sub-activity is proposing that if we can strengthen the technical, managerial and organizational capacities of the major actors in the small ruminant value chain, it will go a long way towards addressing some of the aforementioned challenges. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 To increase small ruminant value chain input and output services | | | | | | | | | | | | | | |
| 2.2 To improve the technical, organizational and managerial capacities of small ruminant value chain actors in northern Ghana | | | | | | | | | | | | | | |
| 2.3 To strengthen linkages among small ruminant actors | | | | | | | | | | | | | | |
| 2.4 To increase women and youth participation in small ruminant value chain activities | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | |
| 3.1 Will a Research for Development Platform improve small ruminant value chain input and output services? | | | | | | | | | | | | | | |
| 3.2 How will the technical, organizational and managerial capacities of small ruminant value chain actors in northern Ghana be improved? | | | | | | | | | | | | | | |
| 3.3 How will linkages among small ruminant actors be strengthened? | | | | | | | | | | | | | | |
| 3.4 How will women and youth participation in small ruminant value chain activities be increased? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| Actors of small ruminant value chains in intervention districts will be engaged in Research for Development Platforms. A workshop will be organized for them to prioritize constraints. A visit will be paid by a core team of Platform members to Burkina Faso to gain an understanding of how they have developed their ruminant market with the view to adopting best practice.  A baseline survey will be conducted in the two intervention districts. The baseline information will include the level of organization of existing small ruminant value chains, level of adoption of proven technologies by actors and linkages to other actors and markets.  Brainstorming sessions will play a key role in decision-making on these platforms. The platforms will organize regular meetings. Both biophysical and institutional constraints will be addressed so as to make it profitable to adopt proven technologies and improved practices. Individuals and teams will be tasked to address identified constraints. Monitoring and evaluation will be carried out. Processes and results will be documented.  Animal Research Institute will be responsible for the overall management of the study. The platforms will be responsible for identifying platform members for the execution of specific tasks identified. Each Platform has its own executives made up of a Chairperson, a Vice, Secretary and Treasurer. The platforms will be self-sustaining by conducting stakeholder mapping and analysis around different actors in the small ruminant value chain. Their capacities will be built-in governance mechanisms and record-keeping among others. Frequency of platform meetings will be determined by its members and based on the number of tasks to be accomplished within a specified time. It may, therefore, be monthly or bimonthly. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | Responsibility/Institute | | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | | | |  | | | |
| 5.1 Baseline survey data on the level of organization of existing small ruminant value chains, level of adoption of proven technologies by actors and linkages to other actors and markets. | | | | | | | | | | | ARI and DoA | | | |
|  | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | |
| Deliverables | | | | | | | | | Means of verification | | | | Delivery date | |
| R4DPs established | | | | | | | | | List with members of R4DPs | | | | Aug. 2019 | |
| Prioritization workshop | | | | | | | | | Workshop report | | | | Sep. 2019 | |
| Trip to Burkina Faso | | | | | | | | | Trip report | | | | Sep. 2019 | |
| Baseline survey to establish:   * Level of organization * Level of linkages * Level of technology adoption * Sales * Quality of animals | | | | | | | | | Baseline survey report | | | | Nov. 2019 | |
| Operational platforms: Number of constraints addressed  Number of value chain actors trained | | | | | | | | | A report on the operation of the platform including capacity building | | | | Mar. 2020 | |
| Training handbooks produced | | | | | | | | | Handbooks uploaded on CG space | | | | Mar. 2020 | |
| Contribution towards finalization of West Africa Handbook | | | | | | | | | West Africa Handbook | | | | Feb. 2020 | |
|  | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | |
| Domain | | | Indicator | | | | Metrics/Scale | | | | | | | |
| 7.1. Productivity | | | Animal productivity | | | | Animal numbers  (number/hh/yr) at the hh level  Animal by-products  (by-product/hh/yr) | | | | | | | |
| 7.2 Environmental | | | Soil biology  Soil chemical quality | | | | Total carbon (% or mg/ha) at field level  Soil pH at field level  Soil nutrient levels at field level | | | | | | | |
| 7.3 Economic | | | Profitability  Labor requirement | | | | Net income (total net income for small ruminant activities) at the household level  Labor requirement (hours) at hh level  Farmer rating of labor at hh level | | | | | | | |
| 7.4 Social | | | Gender equity  Collective action | | | | Capacity  Access to information at hh level  Collective action groups at the community level | | | | | | | |
| 7.5 Human | | | Nutrition  Capacity to experiment | | | | Access to nutritious foods at hh level  Number of new practices being tested at hh level | | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | |
| Scaling will be done through a series of meetings and deliberations, increasing the membership of platforms and the formation of new strategic partnerships with NGOs and DoA for the establishment of new value chains. Members’ capacities will be built-in governance, record keeping and management among others to ensure continuity of platform meetings and activities even after the project has ended. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | |
| * Number of value chain actors trained | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Weak linkages among actors in the goat value chain in northern Ghana which if well addressed will enhance participation of smallholder small ruminant producers in the value chain thereby improving their income. | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Service providers, input suppliers, small ruminant farmers, traders, transporters, processors and consumers. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 12. Budget (USD) | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | | | | **ARI1** |
| Personnel | | | | | | | | | | | | | | 3,000 |
| Services | | | | | | | | | | | | | | 3,300 |
| Supplies | | | | | | | | | | | | | | 3,000 |
| Capital | | | | | | | | | | | | | | 0 |
| Travel | | | | | | | | | | | | | | 3,450 |
| Overhead | | | | | | | | | | | | | | 2,250 |
| **Total GH311-19** | | | | | | | | | | | | | | **15,000** |

1ARI will be contracted through ILRI

13. Gantt chart

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/Month** | **2019** | | | | | **2020** | | | | | |
| **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** |
| GH3111-19 |  |  |  |  |  |  |  |  |  |  |  |
| Identification of existent platform |  |  |  |  |  |  |  |  |  |  |  |
| Cross-visitation by core team members and contact persons in Burkina Faso to give further recommendations on how to strengthen existing platform |  |  |  |  |  |  |  |  |  |  |  |
| Baseline survey data on level of organization |  |  |  |  |  |  |  |  |  |  |  |
| Stakeholder mapping and analysis |  |  |  |  |  |  |  |  |  |  |  |
| Improve the technical, organizational and managerial capacities of small ruminant value chain actors in northern Ghana |  |  |  |  |  |  |  |  |  |  |  |
| Strengthen linkages among small ruminant actors |  |  |  |  |  |  |  |  |  |  |  |
| Monitoring, evaluation and reporting |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 3: Farmers and other value chain actors have greater and equitable access to production assets and markets (input and output) through enabling institutions and policies. | | | | | | | | | | | |
| a. Output 3.2 | | | | Options to increase access to production assets and increase participation in decision-making by women, youth and other vulnerable groups. | | | | | | | |
| b. Activity 3.2.1 | | | | Identify constraints to, and opportunities for increasing women and youth access to production assets in the target area. | | | | | | | |
| c. Sub-activity GH3211-19 | | | | Evaluate risk and vulnerability as well as resilience within maize-cowpea living mulch systems in relation to smallholder farmers’ livelihoods. | | | | | | | |
|  | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | |
| Name | | | | Institution | | | | Role | | | |
| Wilson Agyei Agyare | | | | KNUST | | | | PI: Soil and water management | | | |
| Fred Kizito | | | | IITA | | | | Co-PI: Land and water management | | | |
| B. O. Antwi | | | | Soils Research Institute | | | | Soil and water management | | | |
| Abdul Rahman Nurudeen | | | | IITA | | | | Cereal agronomy and plant nutrition | | | |
| Gundula Fischer | | | | IITA | | | | Gender and social aspects | | | |
| Benedict Boyubie | | | | IITA | | | | FtF indicators and ensure data upload on Dataverse | | | |
|  | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | |
| Name | | | Institute | | | Degree | | | Start | | End |
| Ernestina Anan | | | KNUST | | | MPhil | | | 2018 | | 2020 |
|  | | | | | | | | | | | |
| f. Location(s) | Northern (Tingoli, Cheyohi no. 2, Doku, Tibali) | | | | | | | | | | |
|  | | | | | | | | | | | |
| g. Start | Aug 2017 | | | | | | | | | | |
|  | | | | | | | | | | | |
| h. End | December 2020 | | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | |
| As discussed in sub-activity GH121-1902 that looks at assessing the impact of soil and water conservation interventions on resilience in a maize-cowpea living mulch system, this sub-activity complements the former in that it evaluates the risk and vulnerability as well as resilience within the maize-cowpea living mulch systems in relation to smallholder farmers’ livelihoods. This allows us to explore risk and resilience issues within maize-cowpea living mulch systems and how these can inform us on options towards reducing vulnerabilities of smallholder farmers while increasing their livelihood opportunities. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | |
| 2.1 Evaluate risk and resilience within maize-cowpea living mulch in relation to smallholder farmers’ livelihoods. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 3. Research Questions | | | | | | | | | | | |
| 3.1 How would evaluation on risk and resilience issues within maize-cowpea living mulch systems inform on reducing vulnerabilities of smallholder farmers and increase their livelihood opportunities? | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.). | | | | | | | | | | | |
| To develop effective, measurable resilience-building strategies, we will consider the complex interactions that exist between risks, people and the socio-ecological systems in which they live. These interactions occur at various spatial and temporal scales and are inherently dynamic. Thus, when shocks hit a system, they do not occur in isolation; rather, they interact with multiple factors that can compound their impact and provoke downstream effects. Understanding social-ecological systems, for instance, requires understanding how people think, engage with one another and their environment, and react to and affect changes from the local level to the community, regional and national level. For this sub-activity, we shall principally consider the local to community levels and will use biophysical and ecological modeling, focused group discussions and economic tools as well as the SIAF to allow for a systems approach to the desired analysis.  This sub-activity will follow USAID’s resilience guidance notes[[47]](#footnote-47) and will entail 4 steps:  Step 1: Planning and design in order to determine the purpose (how will this analysis be used, by whom), scope and scale of the assessment as well as the level of effort while taking stock of existing data, identifying knowledge gaps and creating a research plan to respond to key questions on resilience capacities and risks. This will be followed by:  Step 2: Data Collection which will entail qualitative and quantitative data from primary and/or secondary sources to fill knowledge gaps identified in Step 1.  Step 3: Analysis. Combine and interpret data to answer key questions as determined in Step 1.  Step 4: Strategic Planning. Translate findings into appropriate outputs, based on the purpose of the assessment. Possible outputs include resilience-building programmatic strategies. In order to measure absorptive, adaptive and transformative capacities of resilience at the household and community scales, we intend to link aspects of resilience to the SIAF at the aforementioned scales | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | |  | |
| 5.1 For resilience:  We shall focus on primary qualitative and quantitative data at a high level of spatial resolution supported by secondary data and external studies; in order to measure absorptive, adaptive and transformative capacities of resilience at the household and community level. We intend to link aspects of resilience to the SIAF at both scales; sample data sets will include human well-being data and livelihood data from surveys as well as biophysical data on weather/climate. | | | | | | | | | | F. Kizito/IITA and E. Annan/KNUST | |
| 5.2 Co-share with end-user’s adaptation and resilience insights:   * Resilience Assessment Level of Effort Matrix * Risk and vulnerability qualitative data from FGDs (focus group discussion) and Key Informant Interviews * Knowledge, Attitude, Skills and Aspirations (KASA) analysis | | | | | | | | | | F. Kizito/IITA and the team | |
|  | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | |
| Deliverables | | | | | Means of verification | | | | | Delivery date | |
| 6.1 Synthesis on resilience in cereal-legume farming systems in the context of land and water management strategies | | | | | Interim Project Report with farmer decision charts for cropping calendars | | | | | Feb. 2020 | |
|  | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | |
| Domain | | Indicator | | | | | Metrics/Scale | | | | |
| 7.1 Productivity | | Crop productivity | | | | | Yield (kg/ha/season) at the field/plot level | | | | |
| 7.2 Environmental | | -Erosion  -Soil water storage | | | | | -Soil loss (tons/ha/season) at the plot level  - Seasonal soil moisture storage mm/m | | | | |
| 7.3 Economic | | - Profitability  - Input Use Intensity | | | | | - Net income ($/crop/ha/season) at the plot level  - Input per ha at the plot level | | | | |
| 7.4 Social | | - Gender equity  - Collective action | | | | | -Capacity: Access to information (Household)  - Participation in a collective action group (Household) | | | | |
| 7.5 Human | | Capacity to experiment | | | | | - Number of new practices being tested (Household level)  -% of farmers experimenting (Community level) | | | | |
|  | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | |
| We shall liaise with MoFA, from the private sector with specifically WorldCover, and with local universities.We also intend to liaise and engage closely with Texas A&M on work towards modeling resilience of systems using both current and legacy data products. This will allow us to reach broader audiences and publish our work. The use of ICT approaches in collaboration with ESOKO and WorldCover as well as participatory video methods and maps will be used as information sharing methods in the target sites with partners and will complement the scaling-up and out through farmer to farmer exchanges on soil and land management interventions that increase on-farm productivity. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | |
| The activities are related to sub-activities GH1111-19 and GH1212-19. This is an integrative activity in that IITA and KNUST will collaborate on soil and water conservation incorporation within farming systems. The resilience aspects emphasized in this work plan will be complementary to the work proposed by WUR and vice versa. The IITA component will rely heavily on an approach promoted by USAID[[48]](#footnote-48) complemented with field measurements while the WUR will rely on modeling and farming typologies. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | |
| * Synthesis: Resilience in cereal-legume farming systems in the context of land and water management strategies * KASA Analysis | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  If communities are not resilient, they remain exposed and vulnerable. Through this research, the sub-activity will seek information about the vulnerabilities and resilience capacities of the target communities and how this contributes towards reducing food insecurity and poverty and enhance the natural resource base. | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Smallholder farmers, agricultural extension agents, donors (USAID) and policymakers. | | | | | | | | | | | |

|  |  |  |
| --- | --- | --- |
| 12. Budget | | |
| **Budget line item** | **IITA** | **KNUST** |
| Personnel | 2,000 | 3,000 |
| Services | 2,000 | 600 |
| Supplies | 3,000 | 700 |
| Capital | 1,000 | 1,000 |
| Travel | 1,000 | 700 |
| Overhead | 0 | 600 |
| **Total** | **9,000** | **6,600** |
| **Grand total** | **15,600** | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | | | **2020** | | | |
| **Jul** | **Aug** | **Sep** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** |
| Training |  |  |  |  |  |  |  |  |  |
| Refining elements |  |  |  |  |  |  |  |  |  |
| Finalizing content\* Includes support to other Book Chapters |  |  |  |  |  |  |  |  |  |
| Stock of existing data |  |  |  |  |  |  |  |  |  |
| Identification of knowledge gaps |  |  |  |  |  |  |  |  |  |
| Plan on resilience/risk capacities |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |
| KASA Analysis |  |  |  |  |  |  |  |  |  |
| Analysis and strategic insights |  |  |  |  |  |  |  |  |  |
| Link resilience to cropping calendar |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices. | | | | | | | | | | | | | |
| a. Output 4.1 | | | Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices to scale. | | | | | | | | | | |
| b. Activity 4.1.1 | | | Conduct cost-benefit and gender analysis coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts. | | | | | | | | | | |
| c. Sub-activity GH4111-19 | | | Conduct simulation and other socio-economic analyses of selected SI technologies/practices for different farmer contexts, to have a better understanding of the adoption potential of these proven technologies and opportunities for scaling up. | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | |
| Name | | | | Institution | | | | Role | | | | | |
| Adams Abdulai (Agricultural Economist) | | | | CSIR-STEPRI | | | | Lead (Research design, analysis and reporting) | | | | | |
| Mavis Boimah (Agricultural Economist) | | | | CSIR-STEPRI | | | | Research design, data collection and reporting | | | | | |
| Nana Yamoah (Agricultural Economist) | | | | CSIR-STEPRI | | | | Data collection and analysis | | | | | |
| Livingston Caesar (Business Management) | | | | CSIR-STEPRI | | | | Data collection and analysis | | | | | |
| Benedict Boyubie | | | | IITA | | | | FtF indicators and ensure data upload on Dataverse | | | | | |
|  | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | |
| Name | | Institute | | | Degree | | | | Start | | | End | |
| NIL | |  | | |  | | | |  | | |  | |
|  | | | | | | | | | | | | | |
| f. Location(s) | Upper West, Upper East, North East, Northern and Savannah Regions | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| h. End | August 2021 | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | |
| Technology adoption is critical in achieving sustained productivity, for improved food and nutrition security, and in raising the incomes of farmers. While various crop, livestock and nutrition technologies have been generated and validated, the adoption of these technologies by farmers remains low, uneven, and varies based on ecological, environmental, technology features and farmer specific characteristics. The implementation of most SI technologies is still at the farm trial stage with financial and technical support from the project.  Questions have been raised about the ability of farmers to sustain the adoption of these technologies in the absence of financial and technical support from the project. Evidence on the real nature and impact of SI technologies adoption is also limited. A relatively large body of literature has analyzed the effects of agricultural technology adoption on farm incomes and its links with food and nutrition security (Shiferaw *et al*., 2014[[49]](#footnote-49), Snapp and Fisher, 2015[[50]](#footnote-50)). However, assessing the impact of adopted technologies on target beneficiaries and what policy strategies need to be put in place to support the scale-up of these proven technologies is hardly conducted. How the adopted technologies complement each other and how meaningful integration of these technologies could be for greater impact has not been explicitly explored. Improving access to technologies, markets, and productivity-enhancing inputs hold the promise of improving diets of smallholder farm households (Koppmair, Kassie, and QAIM, 2016[[51]](#footnote-51)).  The Africa RISING project has been promoting SI technologies to sustainably increase agricultural productivity, raise incomes and reduce poverty. These technologies require the use of modern inputs such as improved crop varieties, chemical fertilizers, livestock management practices, and preservation of soil fertility through intercropping. This study seeks to analyze the potential impact of selected technologies (on nutrition, livestock, and crop productivity) under two scenarios (adoption and non-adoption) for farmers under the Africa RISING intervention in northern Ghana.  From the SI delivery pathway assessment done by STEPRI under this project, the commonly adopted technologies among farmers include row planting, intercropping, maize stripping, living mulch, and the use of stress-tolerant maize varieties. These adopted technologies will form the basis for this study.  Trade-off analysis minimum data model (TOA-MD) (Stoorvogel *et al*., 2008)[[52]](#footnote-52) will be used to analyze the potential impact of the adoption of the different technologies under constructed scenarios (nutrition, livestock, and crop productivity). TOA-MD is a policy decision support tool designed to quantify the trade-offs between key sustainability indicators under different policy and technological settings. The model serves as a useful approach to informing the policy decision-making process. It establishes a sound scientific basis for quantifying trade-offs that exist with alternative production systems, without attempting to value impacts.  The model is designed to simulate what would be observed if it were possible to conduct a controlled experiment in which a population of farms is offered the choice of continuing to use the current or “base” production system (System[[53]](#footnote-53) 1) or choosing to adopt a new production system (System 2) under Sustainable Intensification Practices. Using survey, experimental and crop models data in combination with Sustainable Intensification scenarios, the TOA-MD model simulates and compares economic outcomes from the two systems (1 and 2) assumed to be operating under altered conditions (Antle *et al*., 2010[[54]](#footnote-54)). No work has so far been done in this area in the Africa Rising project and information available on adoption stimulation is generally scanty.  Trade-off curves, which are easy to understand by policymakers, using the economic principles of opportunity costs will be used in presenting the results. These curves are not only intuitive but allow for the actual quantification of the impacts of technologies adopted.  The analysis will give indications for which types of farmers are likely to use which technologies and the expected outcomes. These insights are needed by policymakers, donors/investors, government agencies (MOFA), and farmers themselves in guiding their decision-making processes. For instance, the evidence generated from the simulation could be used as key messages by extension officers to scale up the adoption of identified technologies with greater impacts.  The findings from the study will be disseminated among key stakeholder (farmers, researchers, policymakers, private sector actors etc.) through learning workshops, policy dialogue/engagements, policy briefs, and publication. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | |
| 2.1 To analyse the potential gains in net farm returns, per capita incomes and poverty rates of farms that adopt SI technologies/practices (System 2-made of different scenarios) compared to those who remain with conventional practices or “business as usual” (System 1) in order to inform policy decisions and private entrepreneurs which SI technologies to promote for greater impact. | | | | | | | | | | | | | |
| 2.2 To examine the potential losses in net per farm returns, per capita incomes and poverty rates for smallholder farms in northern Ghana with and without adoption to inform government policy on agricultural programmes (e.g. Planting for Food and Jobs). | | | | | | | | | | | | | |
| 2.3 To determine the potential adoption rates of the adapted technology among smallholder farmers. | | | | | | | | | | | | | |
| 2.4 Determine the potential uptake of AR SI technologies without project intervention and assess the profile of likely implementers in order to influence policymakers at different hierarchies (community, district and national). | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | |
| 3.1 What are the potential net gains per farm returns, per capita incomes and poverty rates of farms that adopt SI technologies/practices (System 2-made of different scenarios) compared to those who remain with the conventional practices (System 1)? | | | | | | | | | | | | | |
| 3.2 What are the potential net losses per farm returns, per capita incomes and poverty rates for smallholder farms in Northern Ghana with and without the adaptation of SI practices/technologies? | | | | | | | | | | | | | |
| 3.3 What are the potential rates of adoption of technologies being practiced among smallholder farmers? | | | | | | | | | | | | | |
| 3.4 What is the potential for uptake of AR SI technologies - which types of farmers are likely to use them and with what expected outcomes? | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | |
| Purposive selection of adopted technologies across various domains (nutrition, livestock, crop productivity). Close consultation with the PIs leading the implementation of technologies in these areas will be done to inform the final technologies and the sample size. The survey approach will be adopted, and gender and age considerations will be applied to ensure greater women and youth involvement in the sample. A structured questionnaire complemented with focus group discussion guides will be developed and used in gathering both qualitative and quantitative data for analysis.  To analyze the potential impact of SI technology adoption on farm households, four concrete technologies introduced to farmers and validated will be selected and used as technology variables in our modeling. The technologies selected are the row planting (maize), maize stripping, maize-cowpea intercropping, and nutrition messaging and the choice is based on observed wider practice by farmers on the field. Contact was made with each of the activity leaders and discussions on what the proposed activity intends to achieve and their support sorted during the recent field visit made by STEPRI team to project locations. However, adjustment to this choice may be made after close engagement with researchers (PIs) generating and disseminating these technologies, to ensure relevance and avoid duplications.  The trade-off analysis minimum data (TOA-MD) model, which is a simulation tool for multidimensional impact assessment will be used to simulate the potential adoption and impacts of these technologies. The survey data, experimental and crop models data together with sustainable intensification scenarios, will be used to simulate and compare economic outcomes from two Systems (1and 2). The key assumption is that the two systems are operating under altered conditions. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | | |  | | | |
| 5.1 Farm household survey data | | | | | | | | | | CSIR-STEPRI | | | |
|  | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | | Date of delivery | | |
| 6.1 Insights in potential SI adoption impacts of selected validated technologies/practices | | | | | | | Technical Reports | | | | Sep. 2020 | | |
| 6.3 Household survey data on socio-economic, productivity and ecologically variables | | | | | | | Datasets uploaded to Dataverse | | | | Dec. 2020 | | |
| 6.4 Proceedings and synthesis of stakeholder knowledge sharing and validation workshop | | | | | | | Knowledge sharing event report | | | | Jul. 2020 | | |
|  | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | |
| Domain | | Indicator | | | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | | Crop productivity | | | | Yield (kg/ha) at the field level | | | | | | | |
| 7.2 Environmental | | Soil erosion, Pesticide use | | | | Soil loss (tons/ha/year), Rating of erosion, Active ingredients applied per ha | | | | | | | |
| 7.3 Economic | | Profitability | | | | Profit and income at household level | | | | | | | |
| 7.4 Social | | Social cohesion | | | | Collective action at community level | | | | | | | |
| 7.5 Human | | Capacity to experiment and innovate | | | | Number of farmers experimenting with nutrition technologies at the household level | | | | | | | |
|  | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | |
| The findings of our study will be beneficial to Africa RISING partners and policymakers interested in promoting the adoption of Africa RISING SI technologies for increased incomes and productivity. It will foster the promotion of specific technologies in the area of nutritional practices, livestock feeding and crop production through demonstrated evidence of the potential gains associated with the adoption of these practices. Results of this study will be presented at workshops, conferences, and summarized in a policy brief to inform different groups about the experience with the adoption of these practices/technologies and to show the potential impacts for policy support. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | |
| The proposed activity is directly linked to three other sub-activities (mainly within Outputs 1 and 2) being implemented under the Africa RISING program. First, it is linked to the nutrition domain technologies implemented by UDS (Mahama Saaka) Secondly, it draws on the crops/productivity work being done by IITA (Nurudeen) in northern Ghana. Finally, it will use the technologies generated under the crop/livestock activities being implemented by ILRI and ARI (Ayantunde and Salifu). Our anticipation is to enrich policy discussions with scientifically based impact studies after the adoption of the SI technologies on the livelihoods of beneficiaries in the hope to generate more support from the policymakers. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | |
| * Insights generated on potential impacts of the adoption of selected SI adoption presented in policy briefs, reports and journal articles | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing? Several technologies have been generated and validated under the Africa RISING Program. Several demonstrations have been set up in technology parks and on farmers’ fields to showcase the potential of these technologies and to convince farmers to adopt these technologies. However, evidence of the impacts (potential net gains/losses) that could arise out of the adopted technologies is limited which obstructs policy support. This study is intended to provide both qualitative and quantitative evidence of the impact options of selected adopted technologies to support advocacy and convince policymakers to shift attention to supporting scale-up activities. | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, and/or policymakers?  The primary audience is actors within the policy space in the agricultural sector. The secondary audience includes farmers and extension agents at the community and district levels. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | | | | | **STEPRI** |
| Personnel | | | | | | | | | | | | | 6,000 |
| Services | | | | | | | | | | | | | 3,000 |
| Supplies | | | | | | | | | | | | | 2,000 |
| Capital | | | | | | | | | | | | | 8,000 |
| Travel | | | | | | | | | | | | | 6,500 |
| Subtotal | | | | | | | | | | | | | 25,500 |
| Overhead (15% of sub-total) | | | | | | | | | | | | | 3,825 |
| **Total** | | | | | | | | | | | | | **29,325** |

13. Gantt Chart

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| **Year/ Month** | **2019** | | | | **2020** | | | | | | | | | | **2021** |
| **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **D** | **Aug** |
| GH4111-19 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hold 4 consultation meetings with PIs leading the implementation of SI technologies in various domains (nutrition, livestock, and crop production). |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Literature review and conceptualization to generate insights on potential SI adoption impacts framework |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Summarized synthesis of simulation of potential impact analytical framework |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Design of survey instruments (household surveys and focus group discussion guides). |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Household survey data collection on socio-economic, productivity and ecologically variables. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and synthesis of results (simulation of potential impacts of specific SI technologies adopted) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hold stakeholder knowledge sharing and validation event |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Compilation and submission of technical and financial reports. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Policy dialogue organized with stakeholders |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Generate and submit datasets |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Policy briefs and Journal articles |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices. | | | | | | | | | | |
| a. Output 4.1 | | | | Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices to scale. | | | | | | |
| b. Activity 4.1.1 | | | | Conduct cost-benefit and gender analyses coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts. | | | | | | |
| c. Sub-activity GH4112-19 | | | | Evaluate the impact of sustainable intensification practices on household welfare, poverty, perceived shock, the environment, and food and nutrition security in northern Ghana. | | | | | | |
|  | | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | | Institution | | | | Role | | | | |
| Shaibu Mellon Bedi | | Center for Development Research, ZEF | | | | Team leader, economic analysis and writing | | | | |
| Lukas Kornher | | ZEF | | | | Research design and supervision | | | | |
| Bekele Hundie Kotu | | IITA | | | | Research design and supervision | | | | |
| Joachim von Braun | | ZEF | | | | Research design and supervision | | | | |
| Benedict Boyubie | | IITA | | | | FtF indicators and ensure data upload on Dataverse | | | | |
|  | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | |
| Name | | | Institute | | | | Degree | Start | | End |
| Shaibu Mellon | | | Center for Development Research, ZEF | | | | PhD | 2018 | | 2022 |
|  | | | | | | | | | | |
| f. Location(s) | Northern Region, Upper West Region, Upper East Region | | | | | | | | | |
|  | | | | | | | | | | |
| g. Start | August 2019 | | | | | | | | | |
|  | | | | | | | | | | |
| h. End | December 2022 | | | | | | | | | |
|  | | | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| Much of the impact studies on technology adoption focus on yield and gross income. However, relying on gross income alone for policy decision making geared towards scaling out agricultural innovation may lead to spurious and inaccurate decisions since farmers can easily increase income by reallocating resources from other economic activities given the type of technologies they adopt. Also, differences in variable costs and outputs associated with crop production suggest that gross income and yield alone cannot be relied upon for policy decision making. Therefore, to ascertain the benefits of a technology on household income would require estimating farmers’ return on investment in addition to gross income. Second, most adoption studies fail to capture long term impacts of new technologies on the environment, especially the amount of pesticides usage over time.  Indiscriminate use of pesticides can negatively affect the environment. Hence, understanding the long-term impact of new technologies can play a significant role in scaling out decision making but also on overall human welfare. Third, much of the adoption studies that examined the impact of new technologies on food and nutrition security seldom use both, subjective and objective measures of food and nutrition approaches. However, given the complexity and multidimensionality of food security, relying on one approach may only give a narrow view of food and nutrition security at the household level, and not of those of intra-household or individual level. Hence, to understand the impact of adopting new technologies on household food security would require combining the two approaches. Finally, the common mode of disseminating new technologies in Sub-Saharan Africa is through farmer field schools. The use of incentives and farmer field schools, otherwise known as nudges, to spur adoption of new technologies has hardly been studied in developing countries. However, nudges[[55]](#footnote-55) have been used to spur the adoption of agricultural practices across most developed countries. The Africa RISING project in Ghana provides a special case study to examine how nudges and farmer field schools have spurred farmers adopting new technologies. Results can play a significant role in policy decisions related to input subsidies within the sub-region. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | |
| 2.1 To analyze the factors that influence farmers’ decision to adopt SI practices. | | | | | | | | | | |
| 2.2 To examine effects of adopting SI practices on 1) Crop yields; 2) Household welfare; 3) Return on investment; 4) The environment; 5) Food and nutrition security; a6) Poverty rates and 7) Perceived shocks. | | | | | | | | | | |
| 2.3 To estimate the effectiveness of using nudges (e.g., free inputs and training) to induce adoption of SI practices. | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 Does the adoption of SI practices improve household welfare, return on investments, and the environment? | | | | | | | | | | |
| 3.2 Does the adoption of SI practices improve food and nutrition security of farm households? | | | | | | | | | | |
| 3.3 Does the adoption of SI practices reduce poverty? | | | | | | | | | | |
| 3.4 Do covariate (e.g. floods) and idiosyncratic (e.g., death of a household member) shocks perceived by farmers influence the adoption of SI practices? | | | | | | | | | | |
| 3.4 Are nudges (e.g., free inputs and training) more effective in spurring adoption of SI practices than other conventional approaches (e.g. learning from friends and relatives)? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| Data for this study will be collected to complement existing datasets taken in 2016 (mid-term evaluation data) and 2014 (baseline data). The multi-stage sampling process will be used to select farmers and communities. A similar approach was used in the first and second surveys. In sum, 536 households will be selected from 16 communities across the regions. The communities will include intervention communities, previously intervened communities and non-intervened communities. With the aid of a structured questionnaire, which will be adapted from previous instruments, household information, socio-economic information, plot-level information, and information on farmers perceived shocks will be elicited from farmers. | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | Responsibility/Institute | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | |  | |
| 5.1 Household data, (demographic, production, food and nutrition security, etc.) | | | | | | | | | IITA/ZEF | |
|  | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | |
| Deliverables | | | | | Means of verification | | | | Delivery date | |
| 6.3 Journal paper submitted | | | | | Manuscript[[56]](#footnote-56) | | | | Apr. 2020 | |
| 6.4 Journal paper submitted | | | | | Manuscript | | | | Aug. 2020 | |
|  | | | | |  | | | |  | |

|  |  |  |
| --- | --- | --- |
| 7. Sustainable intensification indicators | | |
| Domain | Indicator | Metrics/Scale |
| 7.1 Productivity | Crop productivity | Yield (kg/ha/season) at the field/ plot level |
| 7.2 Economic | Profitability | Profit ($/ha, intervals), costs ($/ha, intervals), Profits/cost |
| 7.3. Human | Nutrition | HHD, WDS, FV\* |
| 7.4. Environment | Pesticide use | Active ingredient applied/ha |
| \*HHD and WDD denote household dietary diversity and women dietary diversity, while FV represents food variety count. | | |
|  | | |
| 8. How will scaling be achieved? | | |
| This study is expected to contribute to policy design aimed at scaling out SI technologies across the three northern regions, especially those targeted towards reducing poverty and improving food and nutrition security. Results are expected to aid development practitioners, researchers, and extension agents in selecting best-bet technologies for scaling out. | | |
|  | | |
| 9. How are the activities in this protocol linked to those of others? | | |
| The study assesses technologies with respect to farmers’ preferences in order to improve the adoption. Therefore, this study is linked to the Farmers’ preferences for technology attributes and their associated benefits in cereal-legume systems of northern Ghana. | | |
|  | | |
| 10. Custom indicators | | |
| * Published papers in peer-reviewed journals and conference presentations, Policy briefs | | |
|  | | |
| 11. Impact-based summary matrix | | |
| 11.1 What is the development challenge you are addressing?  A myriad of technologies has been developed and disseminated across Sub-Sahara Africa. However, the rates of adoption among farmers within the sub-region continue being low. One of the key reasons associated with the low adoption rate is the failure to assess long-term impacts of these technologies on, for example, return on farmers investment, farmers perceived shock, and food and nutrition security, etc. Cross-sectional data are often used to examine the benefits of these technologies. However, results from cross-sectional data tend to suffer from endogeneity issues. This can contribute to a wrong policy decision. Also, dynamic changes over the years cannot be captured using cross-sectional data. Therefore, we intend addressing these issues by using three panel datasets taken at different time periods to evaluate long term impacts of adopting SI practices on farmers’ household welfare, including food and nutrition security. | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Outputs from this research will be targeted towards researchers, policymakers, and extension officers. | | |

|  |  |  |
| --- | --- | --- |
|  | | |
| 12. Budget (US$) | | |
| **Budget line item** | **ZEF** | **IITA** |
| Personnel | 8,000 | 5,0001 |
| Services |  |  |
| Supplies | 3,000 |  |
| Capital |  |  |
| Travel | 5,000 | 5,000 |
| Overhead |  |  |
| **Total** | **16,000** | **10,000** |
| **Grand total** | **26,000** | |

1IITA scientist’s time cost to supervise the study

13. Gantt Chart

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Activity** | **2019 Period (month)** | | | | | |
| **July** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| Sensitization of farmers across NR and UER |  |  |  |  |  |  |
| Training of research assistants and enumerators |  |  |  |  |  |  |
| Data collection NR |  |  |  |  |  |  |
| Data collection UER |  |  |  |  |  |  |
| Data collation and preliminary analysis |  |  |  |  |  |  |

Note: data collection will be undertaken simultaneously across the two regions. NR and UE denote Northern Region and Upper East Region, respectively.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices. | | | | | | | | | | | | |
| a. Output 4.1 | | | | Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices to scale. | | | | | | | | |
| b. Activity: 4.1.1 | | | | Conduct cost-benefit and gender analyses coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts. | | | | | | | | |
| c. Sub-activity GH 4113-19 | | | | Evaluate farmers’ preferences for technology attributes and their associated benefits in cereal-legume systems of northern Ghana. | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | | Institution | | | Role | | | | | |
| Bekele Kotu | | | | IITA | | | Team leader, research design, economic analysis and writing | | | | | |
| Abdul Rahman Nurudeen | | | | IITA | | | Agronomist, identification and attributes of maize agronomy | | | | | |
| Oyinbo Oyakhilomen | | | | University of Leuven | | | Research design | | | | | |
| Gundula Fischer | | | | IITA | | | Gender analysis | | | | | |
| Abebe Menkir | | | | IITA | | | Maize breeder, identification and assessment of maize attributes | | | | | |
| Fred Kizito | | | | IITA | | | NRM scientist, identification and assessment of environmental attributes of technology | | | | | |
| Benedict Boyubie | | | | IITA | | | FtF indicators and ensure data upload on Dataverse | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | | Institute | | | Degree | | | Start | | | End |
| NIL | | |  | | |  | | |  | | |  |
|  | | | | | | | | | | | | |
| f. Location(s) | Northern Region, Upper West Region, Upper East Region | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | June 2019 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | December 2020 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| Adoption of agricultural technologies usually takes a long time or does not happen at the required level among smallholder farmers. This is partly because technology development does not properly consider the attributes of the technologies that farmers value most. In fact, limited adoption can happen when the technology development process fails to incorporate the traits valued by farmers (Lunduka et al., 2012[[57]](#footnote-57); Dalton, 2003[[58]](#footnote-58)).  While the traits of technologies associated with both consumption and production may be important to guide decisions among smallholder farmers, most studies focus on either one of them at a time. However, considering either consumption related traits or production-related traits of technologies separately may not give a full picture of farmers’ preferences. In fact, unlike farmers in developed countries, smallholder farmers in developing countries are both producers and consumers of their own produce and hence they may evaluate technologies from both production and consumption angles before they decide to grow crops while there are concerns nowadays that technology adoption is associated with unintended adverse effects on the farming system and livelihoods of smallholder farmers.  A good example is the famous green revolution. While the green revolution could reduce rural poverty through rapid growth in productivity (Hazell, 2009[[59]](#footnote-59)), it was associated with negative environmental consequences such as water pollution, and loss of biodiversity (Alauddin & Quiggin, 2008[[60]](#footnote-60); Shiva, 1991[[61]](#footnote-61)) and was thus unsustainable. This implies that sustainability is an important evaluation criterion in the process of technology development. Sustainable intensification entails the application of agricultural technologies (or technology packages) having multidimensional advantages/positive traits (Pretty et al., 2011[[62]](#footnote-62)). Therefore, assessing technologies with respect to farmers’ preferences considering the multidimensional nature of sustainable agricultural intensification is useful to set research priorities and guide policy interventions pertinent to smallholder farmers. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 Identifying important attributes associated with maize production technologies including improved varieties and agronomic practices) as perceived by farmers. | | | | | | | | | | | | |
| 2.2 Assessing the differences in the technology preferences among farmers with respect to gender and farmer typologies. | | | | | | | | | | | | |
| 2.3 Refining technology targeting relevant to farmers’ preferences and providing feedback to researchers, extension agents and development practitioners the key findings of the study. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 What are the attributes of maize production technologies liked by smallholder farmers in Northern Ghana? | | | | | | | | | | | | |
| 3.2 Are there differences among farmers’ categories (gender and other farmer typologies) regarding preferences to technologies attributes? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| We will collect data through a survey of about 600 randomly selected farm households in the three regions of northern Ghana namely, Northern Region, Upper East Region, and Upper West Region. In addition, we will conduct focus group discussions to collect qualitative data on farmers’ preferences and related issues. Discussions with researchers and other key informants will be made. The data from the focus group discussions and the key informant interviews will be used to design the household survey and prepare the questionnaire. The survey will be organized following a choice experiment design in which respondents are asked to choose from the list of different hypothetical technology profiles presented to them. The choice sets will be fixed based on the discussions we will make with farmers, researchers, and other knowledgeable individuals or groups regarding the farming systems in northern Ghana and the performances of different agricultural technologies. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | |  | | |
| 5.1 Survey data of farmers perceptions and socio-economic activities | | | | | | | | | | IITA | | |
| 5.2 Qualitative data; list of identified attributes based on focus group discussions | | | | | | | | | | IITA | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | | Delivery date | |
| 6.1 Insights and perspectives on preferred attributes shared with researchers and extension workers | | | | | | | | Information brief | | | Sep. 2020 | |
| 6.2 Journal paper submitted | | | | | | | | Manuscript | | | Dec. 2020 | |
| 6.3 Household survey data archived | | | | | | | | Survey data submitted to Dataverse repository | | | Dec. 2020 | |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | |
| Domain | | Indicator | | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | | Crop productivity | | | Yield (kg/ha), field level  Yield variability (CV, range), field level | | | | | | | |
| 7.2 Environmental | | Soil fertility | | | Qualitative measure (high/low), field level | | | | | | | |
| 7.3 Economic | | Gross income, cost | | | Gross income (Ghc/ha), costs (Ghc/ha); field level | | | | | | | |
| 7.4 Social | | Social cohesion (collective action), equity | | | Qualitative metrics (low/high, % of farmers); household level | | | | | | | |
| 7.5 Human | | Nutrition | | | Qualitative measure (low/high), household level | | | | | | | |
|  | | | | | | | | | | | | |

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| 8. How will scaling be achieved? |
| This study focuses on technology attributes associated with production and consumption to guide farmers’ decisions for the application of the technology. We hope that the results of the study will help researchers to generate technologies that will have a high chance of adoption. It will also help the government extension department and other development practitioners to prioritize technologies for scaling and do proper targeting which will enhance adoption. To this effect, the implementing team intends to release an information brief and share with various stakeholders. |
|  |
| 9. How are the activities in this protocol linked to those of others? |
| The study assesses technologies with respect to farmers’ preferences in order to improve the adoption. Therefore, this study is linked to the Activity 4.3.1: Monitor and modify the progress of technology adoption process towards scaling as well as to sub-activity 4.1.2: Evaluate the impact of sustainable intensification practices on household welfare, poverty, perceived shock, the environment, and food and nutrition security in northern Ghana. |
|  |
|  |
| 10. Custom indicators |
| * Published papers in peer-reviewed journals and conference presentations * Information brief with relevant recommendations for targeting adoptable interventions |
|  |
| 11. Impact-based summary matrix |
| 11.1 What is the development challenge you are addressing?  Many agricultural technologies have been developed by agricultural research institutions, although a number of constraints considerably limit their adoption. Lack of compatibility of the technologies to farmers needs is one of the reasons for low adoption rates. Technology scaling is easier when technologies are compatible with farmers’ needs and this would happen when farmers’ technology preferences are considered in the process of technology development. One of the limitations in the agricultural research process is the fact that farmers’ preferences are usually overlooked. Moreover, farmers are not homogenous in their preferences while technology development mostly fails to consider such heterogeneities among farmers. Such situations in the research process have resulted in low demands among farmers for new technologies, early dis-adoption, and sub-optimal adoption while making the scaling process quite challenging. This study addresses this challenge in the adoption of agricultural technologies among smallholder farmers. |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Our study targets a large audience including: i) researchers to set research priorities and define the scaling strategies by considering the farmers’ preferences, ii) extension agents for the technologies scaling on the fields, iii) policymakers to guide the policy interventions, and iv) farmers to make available the technologies that meet their needs in terms of consumption and production. |

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| 12. Budget (US$) | |
| **Budget line item** | **IITA** |
| Personnel (casuals and consultants) | 17,000 |
| Services | 5,000 |
| Supplies | 5,000 |
| Capital |  |
| Travel | 8,000 |
| Overhead |  |
| **Total** | **35,000** |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/Month** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | |
| **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| Starting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Focus group discussion/key informant interview |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sampling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Staff recruitment and survey logistics |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Survey |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data organization and analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Drafting paper |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Revising paper and submission to journal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ending |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations, and practices. | | | | | | | | |
| a. Output 4.1 | | Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices to scale. | | | | | | |
| b. Activity 4.1.2 | | Identify (possibly map) and assess relevant stakeholders to establish dialogue for the exploration of mutual synergies for scaling delivery of validated technologies. | | | | | | |
| c. Sub-activity GH4121-19 | | Utilize ICT and GIS tools as a means to share information (agronomic, climatic and market services) and scale-out Africa RISING technologies in collaboration with strategic partnerships in the Region. | | | | | | |
|  | | | | | | | | |
| d. Research team | | | | | | | | |
| Name | | | Institution | | | Role | | |
| Wilson Agyei Agyare | | | KNUST | | | PI: Soil and water management | | |
| Fred Kizito | | | IITA | | | Co-PI: Land and water management | | |
| B. O. Antwi | | | Soils Research Institute | | | Soil and water management | | |
| Abdul Rahman Nurudueen | | | IITA | | | Cereal Agronomy and plant nutrition | | |
| Gundula Fischer | | | IITA | | | Gender and social aspects | | |
| Benedict Boyubie | | | IITA | | | FtF indicators and ensure data are uploaded on Dataverse | | |
|  | | | | | | | | |
| 1. Justification | | | | | | | | |
| Beyond soil and water conservation, field observations in recent years have increasingly shown that farmers’ planning of timing of planting and agronomic management practices (e.g. timing of sowing, thinning, fertilizer application, harvesting and storage) is helpful but needs further refinement and guidance. Proper planning offers numerous dividends such as early crop vigor, drought avoidance, tolerance to pests and diseases. The cropping calendar data from last year revealed interesting dynamics that will be shared with Africa RISING farmers as a resilience enhancing approach. For example, based on the participatory survey data compared with specific planting dates ascertained from satellite data reveals differences between scientific estimations and farmers local knowledge. These will be synthesized into informative charts that assist farmers with more precise decision making. This will be conducted through an integrated way by reaching out and communicating with our target audiences through an ICT platform that combines agronomy, markets, climate services and postharvest information for the benefit of farmer empowerment. | | | | | | | | |
|  | | | | | | | | |
| 2. Objectives | | | | | | | | |
| 2.1 Harness the power of ICT to share cropping-calendar messages and other agronomic, weather and market information for farmers’ information empowerment | | | | | | | | |
|  | | | | | | | | |
| 3. Research Questions | | | | | | | | |
| 3.3 How can we use the power of ICT to co-develop and share with end-users a crop planning calendar for empowering farmer decision making? | | | | | | | | |
| 3.4 What would be the best strategy to map, engage and collaborate with strategic partnerships in the Region as a means to scale out promising SWC measures? | | | | | | | | |
|  | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | |
| Building on accomplishments from the previous season, the team has compiled and analyzed seasonal calendar information for use by farmers and development partners. The team intends to conduct training for efficient use of the seasonal calendar and also provide a refresher training for soil and water conservation measures for the communities in Bonia and Nyangua. The team has partially developed educational brochures and training manuals for educating and training farmers, development partners and extension officers on cropping calendars for improved crop productivity thus developing both human and institutional capacity. The process will be concluded in this research cycle.  Building on activities conducted in sub-activities GH1211-19 and GH1212-19 and GH3211-19in collaboration with ESOKO and WorldCover, we shall use ICT and GIS tools to share and disseminate information on proven agronomic practices as well as on the seasonal calendars (and planting dates information). This activity is an integrating activity across the interventions being promoted within Africa RISING. It will equally entail working closely with other work-packages for packaging the right messages, and timing of message delivery to the end-users. It will also involve awareness-raising on the role and benefits of the platform including both farmers and extension officers. Some of the messages will be tailored around crop agronomy, climate services, market information, and post-harvest management practices. | | | | | | | | |
|  | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | Responsibility/Institute | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | |  | |
| 5.1 Co-share with end-user’s crop planning decision matrix:   * Historical planting dates for major staples * Date calendars for agronomic practices (e.g. timing of sowing, thinning, fertilizer application, harvesting and storage) | | | | | | | F. Kizito/IITA and W. Agyare/KNUST | |
| 5.2 Develop both human and institutional capacity of target farmers towards improved soil and water conservation measures:  We shall assess the knowledge, attitude, skills and aspirations (KASA) of farmers before and after the training and capacity building exercises. The activity will take care of the training and capacity building needs of all the other sub-activities by the team. | | | | | | | F. Kizito/IITA and W. Agyare/KNUST | |
|  | | | | | | | | |
| 6. Milestones | | | | | | | | |
| Deliverables | | | | Means of verification | | | | Delivery date |
| Crop planning decision matrix | | | | Interim Project Report with farmer decision charts for cropping calendars | | | | Feb. 2020 |
| KASA analysis framework on ICT and GIS with extension workers and farmers on access to mobile phone messages | | | | Interim Project Report | | | | Mar. 2020 |
|  | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | |
| Domain | Indicator | | | | Metrics/Scale | | | |
| 7.1 Economic | - Profitability  - Input Use Intensity | | | | - Net income ($/crop/ha/season) at the plot level  - Input per ha at the plot level  In relation to the market information services received from the ICT platform | | | |
| 7.2 Social | - Gender equity  - Collective action | | | | - Capacity: Access to information (Household)  - Participation in a collective action group (Household) in relation to agronomy, climate services and market information | | | |
|  | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | |
| Strategic partnerships with both public and private sector entities. For the public sector: we shall liaise with MoFA, for the private sector specifically with WorldCover, and local universities. The use of ICT approaches in collaboration with ESOKO and WorldCover as well as participatory video methods and maps will be used as information sharing methods in the target sites with partners and will complement the scaling-up and out through farmer to farmer exchanges on soil and land management interventions that increase on-farm productivity. We link up with on-going initiatives and partnerships such as the Northern Agricultural Sector Working Group (NASWG) and Northern Rural Growth Development Program (NRGDP) as scaling pathways for our research. This will include sharing with them brochures developed for farmer training as well as co-sharing in-field experiences at working group discussions including MoFA as well. | | | | | | | | |
|  | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | |
| The activities on cropping calendars and ICT are all-encompassing in the sense that there is information shared on agronomy, climate services and market linkages for the different AR technologies. The training and capacity building will be conducted in liaison with the agronomic work. The proposed work will also link with sub-activity GH3211-19on assessing buffer and adaptive capacity to harness resilience of different farm types. | | | | | | | | |
|  | | | | | | | | |
| 10. Custom indicators | | | | | | | | |
| * Synthesis: Resilience in cereal-legume farming systems in the context of land and water management strategies * Journal article on land and water management strategies in Cereal-Legume based farming systems * Database on land and water management strategies on Cereal legume-based farming systems | | | | | | | | |
|  | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Food insecurity and poverty (household level) and NRM beyond the plot level: Through this research, the sub-activity will seek information about the vulnerabilities and resilience capacities of the target communities and how this contributes towards reducing food insecurity and poverty and enhance the natural resource base. | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Smallholder farmers, agricultural extension agents, donors (USAID) and policymakers. | | | | | | | | |

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|  | | |
| 12. Budget (US$) | | |
| **Budget line item** | **IITA** | **KNUST** |
| Personnel\* | 5,000 | 4,000 |
| Services\*\* | 1,000 | 500 |
| Supplies | 3,000 | 600 |
| Capital\*\*\* | 2,000 | 500 |
| Travel | 3,000 | 600 |
| Overhead | 0 | 760 |
| **Total** | **14,000** | **6,960** |
| **Grand total** | **20,960** | |

Costs of casual workers, drivers, technicians; \*\*Includes costs of engaging ICT consultancy \*\*\*Includes purchase of equipment for soil moisture monitoring.

13. Gantt Chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month** | **2019** | | | | | **2020** | | | |
| **Jul** | **Aug** | **Sep** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** |
| Training |  |  |  |  |  |  |  |  |  |
| Consultancy engagement |  |  |  |  |  |  |  |  |  |
| Designing key messages |  |  |  |  |  |  |  |  |  |
| M&E for verification |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices are built. | | | | | | | | | | | | | | |
| a. Output 4.3 | | | | A framework for monitoring and evaluating technology adoption, and technology-associated risk accessible to the project team and scaling partners. | | | | | | | | | | |
| b. Activity 4.3.1 | | | | Monitor and modify the progress of technology adoption process towards scaling. | | | | | | | | | | |
| c. Sub-activity GH4311-19 | | | | Matching agricultural technologies to farms and their context. | | | | | | | | | | |
|  | | | |  | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | | | Institution | | Role | | | | | | | | | |
| Jeroen Groot | | | WUR | | Farming systems analysis (Activity Leader) | | | | | | | | | |
| Francis Muthoni | | | IITA | | GIS | | | | | | | | | |
| Beliyou Haile | | | IFPRI | | Economic analysis | | | | | | | | | |
| Lieven Claessens | | | IITA | | Farming systems analysis | | | | | | | | | |
| Carlo Azzarri | | | IFPRI | | Economic analysis | | | | | | | | | |
| Benedict Boyubie | | | IITA | | FtF indicators and ensure data upload on Dataverse | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | |
| Name | | Institute | | | | Degree | | Start | | | | End | | |
| Vacancy | | WUR | | | | MSc | | Sep. 2019 | | | | Mar. 2020 | | |
|  | | | | | | | | | | | | | | |
| f. Location(s) | Districts in NR, UER, UWR | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start | 1 September 2019 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End | 1 September 2020 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Increasingly, mobile phones and other ICT services are used to provide information and advice to farmers to facilitate learning, but support to targeting and scaling of agricultural technologies through ICT tools is scarce. ICT-based targeting and scaling approaches should not be considered a silver bullet, although they can increase the reach and reduce the costs of technology dissemination compared to traditional village extension services.  Sophisticated models of technology integration in farming activities exist, but they are often very data-intensive and do not extend beyond the farm level. Muthoni *et al*. (2017)[[63]](#footnote-63) utilized spatially gridded biophysical and socio-economic layers to generate what they called “sustainable recommendation domains” (SRDs) that could be targeted for scaling specific technologies. The effectiveness of the suitability assessment can be further refined as long as the features of individual farms are considered and directly related to technology characteristics during the targeting phase. Innovations in coupling knowledge among site characteristics, household features and technology attributes with the SRDs is needed to guide spatial targeting of suitable technologies.  The FarmMATCH approach explicitly tries to fill this knowledge gap, facilitating the matching between agricultural technologies to farms and their context. It contains 1) a learning and matching algorithm that identifies the most suitable and promising technologies for different farm types, and 2) a data mining and signaling algorithm that identifies hotspots of suitability of technologies and potential adopters. The matching algorithm combines contextual, farm and technology characteristics to create a ranking of the suitability and adoption probability of available innovations. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 Test and improve the ‘matching’ algorithm on a large dataset | | | | | | | | | | | | | | |
| 2.2 Determine the ease of scarce data collection at farms | | | | | | | | | | | | | | |
| 2.3 Obtain feedback from farmers on the technology priority lists | | | | | | | | | | | | | | |
| 2.4 Develop a mechanism for feeding collected data to the database and improve algorithm learning | | | | | | | | | | | | | | |
| 2.5 Develop the ‘signaling’ algorithm | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | |
| 3.1 What is the quality of the generated priority lists for large samples of farms in different agroecological and socioeconomic conditions? | | | | | | | | | | | | | | |
| 3.2 Can the necessary set of scarce data be collected swiftly and reliably from farmers upon farm visit? | | | | | | | | | | | | | | |
| 3.3 What is the farmer perception of the generated priority list of technologies suggested for implementation? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| 4.1 Data collection: GIS and GARBES databases for intervention areas in Northern Ghana will be used to select 1 km2 grid cells with surveyed households. A minimal set of supplementary data on farm and household features and on-farm technologies and practices may be collected.  4.2 We select 15-30 grid cells of 1 km2 from the three Northern regions of Ghana (NR, UER, UWR), so 5-10 cells per region. These cells differ in biophysical conditions (soil, rainfall, etc.) and socio-economic circumstances (e.g. distance to market). Moreover, within these cells we have at least 10 households sampled within the GARBES database collected by IFPRI; if this is not the case then additional data collection is required. In total ca. 300 farms will be included. There should also be diversity among the sampled households in the grid cell. For each household, we analyze in particular the main, easy to collect farm and household features (size, objectives, livestock, crop number, % off-farm income, etc.) and relate these to the farm practices and project-proposed technologies and techniques. The matching algorithm combines the GIS-derived data on biophysical conditions and socio-economic context circumstances with the farm features, to estimate the probability of use of the various technologies and techniques. The data set will be divided between a training set (n=200-240) and a testing set (n=60-100). | | | | | | | | | | | | | | |
|  | | | | | | | | | |  | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | | |  | | | | |
| 5.1 Compiled dataset | | | | | | | | | | WUR | | | | |
| 5.2 Programmed algorithms | | | | | | | | | | WUR | | | | |
|  | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | | | Delivery date | |
| 6.1 Journal article | | | | | | PDF of submitted paper | | | | | | | 1 Sep. 2020 | |
| 6.2 MSc thesis student report | | | | | | PDF of report | | | | | | | 1 Sep. 2020 | |
| 6.3 Datasets and algorithms | | | | | | Items uploaded in Dataverse | | | | | | | 1 Sep. 2020 | |
|  | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | |
| Domain | | | Indicator | | | | Metrics/Scale | | | | | | | |
| 7.1 Human condition | | | Capacity to experiment | | | | Willingness to implement a new farm configuration after disturbance | | | | | | | |
| 7.2 Social | | | Equity | | | | Rating of farm configurations per group and agency (leadership roles) | | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | |
| The modeling results will be discussed in farmer meetings. Findings will be shared and published. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| The activity is linked to GH1211-19 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | |
| * Journal paper * MSc Thesis | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Increasingly, mobile phones and other ICT services are used to provide information and advice to farmers to facilitate learning, but support to targeting and scaling of agricultural technologies through ICT tools is scarce The FarmMATCH approach explicitly tries to fill this knowledge gap, facilitating the matching between agricultural technologies to farms and their context. | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Smallholder farmers, agricultural extension agents, and policymakers | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | |
| **Budget line item** | | | | | | | | | **WUR** | | **IITA** | | | **IFPRI** |
| Personnel | | | | | | | | | 11,000 | | 0 | | | 0 |
| Services | | | | | | | | | 0 | | 1,000 | | | 1,000 |
| Supplies | | | | | | | | | 0 | | 0 | | | 0 |
| Capital | | | | | | | | | 0 | | 0 | | | 0 |
| Travel | | | | | | | | | 1,300 | | 1,000 | | | 1,000 |
| Overhead | | | | | | | | | 1,650 | | 0 | | | 0 |
| **Total** | | | | | | | | | **13,950** | | **2,000** | | | **2,000** |
| **Grand total** | | | | | | | | | **17,950** | | | | | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/Month** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | |
| **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| Starting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Make GIS maps with grid cells |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Compile ARBES data in relational DB |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Test machine learning algorithms on data |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Drafting paper for scientific journal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Revising paper and submission to journal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ending |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices are built. | | | | | | | | | | |
| a. Output 4.3 | | | | A framework for monitoring and evaluating technology adoption, and technology-associated risk accessible to the project team and scaling partners. | | | | | | |
| b. Activity 4.3.1 | | | | Monitor and modify the progress of technology adoption process towards scaling. | | | | | | |
| c. Sub-activity GH4312-19 | | | | Addressing constraints limiting adoption of SI technologies as a result of competing interests for natural and other household resources. | | | | | | |
|  | | | |  | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | | Institution | | Role | | | | | | |
| Alhassan Lansah Abdulai | | CSIR-SARI | | Lead Investigator: Coordination of sub-activity, data collection, data analysis and final report | | | | | | |
| Iddrisu Yahaya | | CSIR-SARI | | Coordination of the development of survey instrument, training of enumerators, data collection and analysis, and report on competing interests | | | | | | |
| Ramson Adombilla | | CSIR-SARI | | Assist in data collection and development of management strategies for competing interests | | | | | | |
| Fred Kizito | | IITA | | Overall guidance, contributing to the development of survey instrument, data analysis and development of management strategies for competing interests | | | | | | |
|  | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | |
| Name | | Institute | | | | | Degree | | Start | End |
| Nil | |  | | | | |  | |  |  |
|  | |  | | | | | | | | |
| f. Location(s) | | Northern Region (Tingoli, Cheyoli No2 and Doku ); Upper West Region (Guo, Goli and Goriyiri); Upper Eat Region (Nyangua, Gia and Bonia) | | | | | | | | |
|  | |  | | | | | | | | |
| g. Start | | December 2019 | | | | | | | | |
|  | |  | | | | | | | | |
| h. End | | October 2020 | | | | | | | | |
|  | |  | | | | | | | | |
| 1. Justification  Northern Ghana has a very fragile climate which requires use of sustainable intensification interventions to ensure that smallholder farmers are able to benefit from the natural resource base. In turn, this will require adoption of sustainable intensification technologies that will bolster productivity, increase income and improve household nutrition for women and children while not deteriorating the natural resource base. Adoption of SI technologies will enhance resilience and adaptive capacity through reduced risks and/or increased productivity of smallholder systems. However, promoters and disseminators of SI technologies (researchers and extension agents) need to understand and properly manage issues of competing interests for natural and other household resources required for SI technologies in order to increase the chances of adoption. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives: The study seeks to understand competing interests for natural and other household resources and propose strategies in order to address constraints to adoption of SI technologies | | | | | | | | | | |
| 2.1 Increase understanding of promoters and disseminators of SI technologies on competing interests for natural and household resources required for SI technologies uptake and adoption | | | | | | | | | | |
| 2.2 Identify and document competing interests for natural and other household resources required for SI technologies | | | | | | | | | | |
| 2.3 Propose strategies for managing competing interests for natural and other household resources for increased adoption and continuous use of SI technologies | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 Are there competing interests for the natural and other household resources required for successful adoption of SI technologies? | | | | | | | | | | |
| 3.2 Which SI technologies have low adoption rate as a result of competing interests, for natural and other household resources, from existing production and/or livelihood systems? | | | | | | | | | | |
| 3.3 To what extent will promoters’ and disseminators’ understanding and management of competing interests for resources influence the adoption and continuous use of SI technologies? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| * Review of project documentation to compile and profile SI technologies disseminated and promoted since the inception of the project * Community entry and sensitization on the sub-activity * Focused group discussions to decipher and document SI technologies disseminated and promoted at each of the communities * Focused group discussions and individual interviews to determine and document cases of conflicting claims for natural and other household resources between the promoted SI technologies and already existing technologies * Participatory planning, implementation and evaluation of mitigation strategies for managing conflicting claims to resources * Develop and publish checklist of competing claims | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | |  | | |
| 5.1 Survey Data: Data on competing claims for natural and other household resources | | | | | | | | Iddrisu Yahaya/ SARI | | |
| 5.2 Proposed strategies for managing competing interests for natural and other household resources | | | | | | | | The whole team | | |
| 5.3 Domains of extrapolation for strategies (Dec. 2020) | | | | | | | | Alhassan Lansah Abdulai/ SARI | | |
| 6. Milestones | | | | | | | | | | |
| Deliverables | | | Means of verification | | | | | | Delivery date | |
| 6.1 Database upload from the survey data | | | Dataverse | | | | | | Jul. 2019 | |
| 6.2 Analysis report on competing interests for natural, human, financial resources of farmers | | | Project report on CGSpace | | | | | | Oct. 2020 | |
| 6.3 Recommendations for managing competing interests for natural and other household resources | | | Project report CGSpace | | | | | | Oct. 2020 | |
| 6.4 Paper publication | | |  | | | | | | Jan. 2021 | |
| 6.5 Focus Group discussions on insights from conflicts | | | Field visits,  Semi-Annual Project Report | | | | | | Jan. 2020 | |
|  | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | |
| Domain | Indicator | | | | | Metric/Scale | | | | |
| 7.1 Social | Collective action  Social Cohesion | | | | | -Incidence of conflicts related to collective action at the household/community/landscape scale  - Participation in social groups at the community/landscape scale | | | | |
| 7.2 Human | Capacity to experiment | | | | | -# of new practices being tested at the community/landscape scale and teasing out if the technologies being promoted enhance innovation and cohesion | | | | |
|  | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | |
| The study will be conducted in all AR-Project communities. Through community focus group discussions farmers are expected to participate and share information amongst themselves but will also share this information beyond their peers in the community and these will serve as vehicles for dissemination. In addition, there will be collaboration with agricultural extension agents from the departments of Agriculture of the Metropolitan Municipal and District Assemblies (MMDAs) who in turn have a wider reach to other farmers beyond the project target communities. | | | | | | | | | | |
|  | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | |
| This activity links to a previous study on work conducted by STEPRI relating to constraints limiting adoption of SI innovation as a result of policy. Hence this study will explore potential synergies with the aforementioned activity. In addition, since this study is focusing on competing interests for resources that could potentially hinder adoption of SI innovations, it will implicitly link to all the project activities. This is because AR strives to ensure that technologies that are being promoted by the project are adopted by the end users. | | | | | | | | | | |
|  | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | |
| * Technical leaflets and reports * -Journal article | | | | | | | | | | |
|  | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing? | | | | | | | | | | |
| Promoters’ understanding and proper management of competing interests for natural and other household resources that are needed for SI technologies, during the dissemination process, will increase chances of adoption. We anticipate that promoters’ understanding of the competing interests will allow for better design strategies that will eliminate or minimize the effect of the competing claims. Chances of adoption will increase if these strategies are included in the package for dissemination. This will lighten the burden of decision making amongst target beneficiaries in light of the fact that there are numerous trade-offs that farmers are faced with in their day to day activities. Therefore, we anticipate that this process will allow for adoption of SI technologies to enhance resilience and adaptive capacity through reduced risks and/or increased productivity. | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policy makers: | | | | | | | | | | |
| The primary beneficiaries include crop farmers, livestock farmers, extension agents, researchers or promoters of the SI interventions. | | | | | | | | | | |
|  | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | |
| **Budget Line** | | | | | **CSIR-SARI** | | | | | |
| Personnel | | | | | 2,000 | | | | | |
| Services | | | | | 1,000 | | | | | |
| Supplies | | | | | 1,000 | | | | | |
| Capital | | | | | 0 | | | | | |
| Travel | | | | | 3,000 | | | | | |
| Overhead (15%) | | | | | 1,050 | | | | | |
| **Total** | | | | | **8,050** | | | | | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2020** | | | | | | | | | |
| **Year/Month** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** |
| Planning meeting by team |  |  |  |  |  |  |  |  |  |  |
| Draft and test survey instrument |  |  |  |  |  |  |  |  |  |  |
| Farmer engagement: Community entry and sensitization |  |  |  |  |  |  |  |  |  |  |
| Roster for conducting FGDs |  |  |  |  |  |  |  |  |  |  |
| Focus Group Discussions in all AR Communities |  |  |  |  |  |  |  |  |  |  |
| Compile and clean Data |  |  |  |  |  |  |  |  |  |  |
| Analysis of Data |  |  |  |  |  |  |  |  |  |  |
| Write Reports |  |  |  |  |  |  |  |  |  |  |
| Draft Publication |  |  |  |  |  |  |  |  |  |  |

## Consolidated budget

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sub-activity** | **Leader** | **IITA** | **ILRI** | **IWMI** | **UDS-FA** | **WorldVeg** | **WUR** | **STEPRI** | **UDS-SH** | **KNUST** | **SARI** | **IFPRI** | **Total** |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable, and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | |
| GH111-1901: Cowpea living mulch effect on weed control, soil properties and maize yield | IITA | 259,512 |  |  |  |  |  |  |  |  |  |  | 259,512 |
| GH111-1902: Optimizing on-farm nitrogen (N) fertilizer use efficiency under rainfed conditions | IITA |  |  | 15,000 |  |  |  |  |  | 8,050 |  | 23,050 |
| GH111-1903: Assessing the potential for a combination of local Napier grass fodder species and pigeon peas for improved soil health and ruminant | UDS-FA | 5,000 |  |  | 19,550 |  |  |  |  |  |  |  | 24,550 |
| GH111-1904: Use CCAFS’ Climate-smart village approach to mainstream climate variability in the promotion and dissemination of Africa RISING SI interventions for sustained productivity and reduced risk in Ghana | SARI |  |  |  |  |  |  |  |  |  | 12,075 |  | 12,075 |
| GH111-1905: Identification of varieties of vegetable crop species with adaptation to Northern Ghana in the dry season | WorldVeg |  |  |  |  | 65,900 |  |  |  |  |  |  | 65,900 |
| GH1116-19: Yield and post-harvest quality of vegetables as affected by improved soil and water management practices in the dry season Northern Ghana (Niangua, Tekuru, Bonia) | WorldVeg |  |  |  |  |  |  |  |  |  |  | 0 |
| GH1121-19: Efficient feed utilization through improved feed troughs | ILRI |  | 95,248 |  |  |  |  |  |  |  |  |  | 95,248 |
| GH1211-19: Assessing buffer and adaptive capacity to harness the resilience of different farm types | WUR |  |  |  |  |  | 45,675 |  |  |  |  |  | 45,675 |
| GH1212-19: Assess the impact of soil and water conservation interventions in maize-cowpea living mulch | KNUST | 13,000 |  |  |  |  |  |  |  | 9,440 |  |  | 22,440 |
| GH1221-19: Evaluate the technical and agronomic performance of Bhungroo and solar energy drip irrigation system in the Upper of Ghana | IWMI |  |  | 135,000 |  |  |  |  |  |  |  |  | 135,000 |
| ***Sub-total Outcome 1*** |  | *277,512* | *95,248* | *135,000* | *34,550* | *65,900* | *45,675* | *0* | *0* | *9,440* | *20,125* |  | *683,450* |
| Outcome 2: More farmers and farm families in the intervention communities are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | | |
| GH2121-19: Using the Power of Radio to Promote women’s empowerment for improved agricultural productivity and nutrition outcomes | USDS-SH |  |  |  |  |  |  |  | 12,075 |  |  |  | 12,075 |
| GH2122-19: Effect of joint nutrition education and homestead vegetable production on household food security, child and maternal nutrition | UDS-SH |  |  |  |  |  |  |  | 26,450 |  |  |  | 26,450 |
| GH2123-19: An Evaluation of Using Mother Care Group Approach/Model in Improving Nutrition Behaviors | UDS-SH |  |  |  |  |  |  |  | 13,455 |  |  |  | 13,455 |
| GH2211-19: Evaluate the threshing efficiency of different maize shellers with regards to grain quality characteristics as influenced by different varieties and harvest timing | SARI |  |  |  |  |  |  |  |  |  | 8,625 |  | 8,625 |
| GH2212-19: Monitoring group dynamics among users of small-scale maize shelling machines in Northern Ghana | IITA | 10,000 |  |  |  |  | 9,346 | 2,000 |  |  |  |  | 21,346 |
| ***Sub-total Outcome 2*** |  | *10,000* | *0* | *0* | *0* | *0* | *9,346* | *2,000* | *51,980* | *0* | *8,625* |  | *81,951* |
| Outcome 3: Farmers and other value chain actors have greater and equitable access to production assets and markets (input and output) through enabling institutions and policies | | | | | | | | | | | | | |
| GH 3111-19: Strengthen the technical, managerial and organizational capacities of the major actors in small ruminants value chain through existent institutional structures such as Farmer-Based Organizations (FBO), District Assemblies (DA), Community Based Organizations (CBO), traders Associations, Transports and input Dealers Association | ILRI |  | 15,000 |  |  |  |  |  |  |  |  |  | 15,000 |
| GH321-1901: Evaluate risk and vulnerability as well as resilience within maize-cowpea living mulch systems in relation to smallholder farmers livelihoods | KNUST | 9,000 |  |  |  |  |  |  |  | 6,600 |  |  | 15,600 |
| ***Sub-total Outcome 3*** |  | *9,000* | *15,000* | *0* | *0* | *0* | *0* | *0* | *0* | *6,600* | *0* |  | *30,600* |
|  | | | | | | | | | | | | | |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at the scale of SI technologies, innovations and practices. | | | | | | | | | | | | | |
| GH4111-19: Conduct simulation and other socio-economic analyses of selected SI technologies/ practices for different farmer contexts, to have a better understanding of the adoption potential of these proven technologies and opportunities for scaling up | STEPRI |  |  |  |  |  |  | 29,325 |  |  |  |  | 29,325 |
| GH4112-19: Evaluate the impact of SI practices on household welfare, poverty, perceived shock, the environment, and food and nutrition security in northern Ghana | IITA | 26,000 |  |  |  |  |  |  |  |  |  |  | 26,000 |
| GH4121-19: Utilize ICT and GIS tools as a means to share information (agronomic, climatic and market services) and scale-out Africa RISING technologies in collaboration with strategic partnerships in the region | KNUST | 14,000 |  |  |  |  |  |  |  | 6,960 |  |  | 20,960 |
| GH4311-19: Matching agricultural technologies to farmers and their context | WUR | 2,000 |  |  |  |  | 13,950 |  |  |  |  | 2,000 | 17,950 |
| GH4312-19: Addressing constraints limiting adoption of SI technologies as a result of competing interests for natural and other household resources | SARI |  |  |  |  |  |  |  |  |  | 8,050 |  | 8,050 |
| ***Sub-total Outcome 4*** |  | *42,000* | *0* | *0* | *0* | *0* | *13,950* | *29,325* | *0* | *6,960* | *0* | *2,000* | 102,285 |
| **Grand total** |  | **338,512** | **110,248** | **135,000** | **34,550** | **65,900** | **68,971** | **31,325** | **51,980** | **23,000** | **28,750** | **2,000** | **898,286** |

# Mali

## Partners and their responsibilities

|  |  |  |
| --- | --- | --- |
| **Name** | **Acronym** | **Role/responsibility** |
| **Government Ministries & Entities** | | |
| Institute d’Economie Rurale | IER | Research on crops, livestock, natural resources management and nutrition. Capacity building to graduate students and national partners |
| Regional Direction of Agriculture in Sikasso | DRA-Sikasso | Scaling out technologies, provision of secondary data on socio-economic aspect |
| **Academic/ National Research Institutions** | | |
| Wageningen University | WUR | Farming systems research, Postgraduate training program. Reports on typologies and farm characterization |
| Institut Polytechnique Rural-De Formation et de Recherche Appliquee Katibougou | IPR-IFRA | Undergraduate and postgraduate training program |
| **Non-Governmental organizations & research institutions** | | |
| Association Malienne d’Eveil et de Développement Durable | AMEDD | Community mobilization, assisting research activities and implementation of field trials in farmers’ field. Facilitating multi-stakeholders interest group meetings. Hosting site coordinators. Capacity building to national partners. Leading implementation of scaling programs in phase II |
| Centre d’Appui a l’Autopromotion pour le Développement | CAAD | Scaling out groundnut technologies. Assisting implementation of animal health and fattening program by ILRI and IER |
| Fédération Nationale pour l'Agriculture Biologique et Équitable | FENABE | Community mobilization to facilitate implementation of field trials in farmers’ field. Work in collaboration with AMEDD on multi-stakeholders interest group meetings in Bougouni |
| Le Groupe de Recherches d’Actions et d’Assistance pour le Développement Communautaire | GRAADCOM | Scaling out groundnut technologies. Assisting implementation of animal health and fattening program by ILRI and IER |
| International Crops Research Institute for the Semi-Arid Tropics | ICRISAT | Mali project management. Consolidation of work plans, technical and financial reports. Activity coordination. Research on crops, natural resources management, socio-economics and scaling strategies. Capacity building to graduate students and national partners |
| International Food Policy Research Institute | IFPRI | Support provision to monitoring and evaluation. Guidance on preparation of work plans to fit into FtF and other custom indicators |
| International Institute of Tropical Agriculture | IITA | Overall project management and scientific guidance. Approval of work plans, evaluation of approved work plans and timely fund release. Organization of regional planning, review and scientific meetings and exchange visits |
| International Livestock Research Institute | ILRI | Research on livestock and scaling out strategies. Capacity building to graduate students and national partners |
| University of Sciences, Techniques and Technologies of Bamako | USTTB | Graduate students’ training |
| The World Vegetable Center | World Veg. | Research on vegetables, nutrition and scaling strategies. Capacity building to graduate students and national partners |

## Planned work

The planned activities are presented in protocols. Activities under each protocol are aimed at achieving the outputs under the four outcomes in the project logframe (see Table 3).

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainable intensified Crop-Livestock systems linked to markets. | | | | | | | | | | | | |
| a. Output 1.1 | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | |
| b. Activity 1.1.1 | | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | | |
| c. Sub-activity MA1111-19 | | | | Evaluating crop simulation models using different fertility sources and climate model outputs to improve the productivity of sorghum. | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | | | Institution | | Role | | | | | |
| Birhanu Zemadim | | | | | ICRISAT | | Activity leader | | | | | |
| Mathew Akinseye Folorunso | | | | | ICRISAT | | Modelling | | | | | |
| Bouba Traore | | | | | ICRISAT | | Farming systems scientist | | | | | |
| Felix Badolo | | | | | ICRISAT | | Economic analysis | | | | | |
| Oumar Samake | | | | | AMEDD | | Community mobilization and multi-stakeholder interest group participation at farmers field day | | | | | |
| Sidi Toure | | | | | ICRISAT | | Field trial implementation in Bamako | | | | | |
| Karamoko Traore | | | | | ICRISAT | | Field trial implementation in Koutiala | | | | | |
| Mahamadou Dicko | | | | | AMEDD | | Field trial implementation in Bougouni | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | Institute | | | | | Degree | | Start | | | End |
|  | |  | | | | |  | |  | | |  |
|  | | | | | | | | | | | | |
| f. Location(s) | Bamako, Koutiala and Bougouni | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | April 2017 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | March 2021 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| Studies have shown that optimum productivity in crops may not be achieved without appropriate fertility management (Traoré, B. *et al.*, 2014[[64]](#footnote-64); Akinseye, F.M. *et al*, 2016 [[65]](#footnote-65)). In the Sudanian region of Mali, where sorghum is an important crop, inorganic fertilizer use is limited due to the high cost and limited availability, and limited soil moisture availability. However, with large available organic resources from livestock and poultry, the study will evaluate different fertilizer response scenarios which will combine both organic and inorganic sources. Our target is to increase productivity (grain and biomass) while biomass production could further be used as a source of feed for the livestock and vice-versa. Furthermore, data collected from different agro-ecologies (Sudanian and Guinea Savana) will be used to set up crop simulation models using APSIM and DSSAT in combination with the climate model output of the Coupled Model Inter-comparison Project Phase 5 (CMIP5) to assess climate change impacts on sorghum yields and to evaluate marginal cost-benefit of different fertility scenarios and varieties as adaptation options to climate change. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 To better understand the physiological functioning and yield potential of sorghum varieties (CSM63E, CSM335 and Fadda) under different fertilizer management regimes (livestock manure and inorganic fertilizer) across different rainfall gradients and soil characterizations. | | | | | | | | | | | | |
| 2.2 Estimate the residual effects of nutrient on crop and water productivity. | | | | | | | | | | | | |
| 2.3 Evaluate the productivity of sorghum for food and feed using the validated crop simulation models (APSIM and DSSAT) under current and future climate conditions based on observations and Global Climate Models (GCMs) output. | | | | | | | | | | | | |
| 2.4 Determine the marginal cost-benefit responses of different fertilizer sources based on current farming practices. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 How to increase sorghum productivity through optimizing fertilizer treatments (in agreement with climate-smart practices) and choosing the appropriate variety? | | | | | | | | | | | | |
| 3.2 Does residual organic matter lead to increased productivity, and how can such intensification pathways encompass environmental benefits? | | | | | | | | | | | | |
| 3.3 What is the sensitivity of the current sorghum yield to climate change using high-resolution climate Models (GCMs) outputs? | | | | | | | | | | | | |
| 3.4 What physiological and soil parameters are important to create suitable crops system models? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| The protocol will follow a Split-Plot Design with 4 replications. The treatments are variety and fertilizer sources. The main plot are varieties include (CSM63E, CSM335 and Fadda). The sub-plot treatment includes the use of synthetic fertilizer (DAP), manure from ruminants, poultry manure and the combination of the manures and NPK. The fertilizer treatments will be as follows: (i) DAP 100 kg/ha; (ii) NPK/DAP micro-dose (3 g/hill), (iii) Cow manure (100 g/hill), (iv) Cow manure (50 g/hill) + poultry manure (50 g/hill), (v) NPK/DAP (3 g/hill) + Cow manure (100 g/hill), (vi) Poultry manure (50 g/hill), (vii) Poultry manure (100 g/hill), (viii) Poultry manure (150 g/hill), (ix) Poultry manure (100 g/hill) + NPK/DAP micro-dose (3 g), and (x) Control. Fertilizer application to be done at sowing. Main plot is 94 rows (70.5 m) x 11 m with a total area of 775.5 m2, and the sub plot is 6 rows (4.5 m) x 3 x 5 m long with a total area of 67.5 m2. Net plot (harvested area) = 2 row x 5 m long = 7.5 m2, and Gross plot = 50 m x 70.5 = 3525 m2. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on data verse | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes (4 yrs) | | | | | | | | | |  | | |
| 5.1 Agronomic (plant phenology) and soil data (texture, moisture) | | | | | | | | | | ICRISAT | | |
| 5.2 Economic data: cost of seed, fertilizer, cow manure, poultry manure, and labor | | | | | | | | | | ICRISAT | | |
| 5.3 Climate data: daily rainfall, temperature, solar radiation and relative humidity | | | | | | | | | | ICRISAT | | |
| 5.4 Soil water measurement and nitrate | | | | | | | | | | ICRISAT | | |
| 5.5 Farmers’ participation in field day | | | | | | | | | | AMEDD & ICRISAT | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | Delivery date | |
| 6.1 Best fertilizer management practices that will contribute to increased sorghum productivity | | | | | | Report on on-station and field trial included in the interim and final report | | | | | Feb. 2020 | |
| 6.2 At least 300 farmers will be reached, trained and sensitized via farmers’ field day on fertility micro-dosing technology | | | | | | Farmers’ field day report prepared by ICRISAT and partners and submitted to IITA | | | | | Dec. 2019 | |
| 6.3 Crop simulation Models (DSSAT and APSIM) recommendations under different fertilizer scenarios to future climatic conditions | | | | | | Adaptation and tailoring of the decision support tool and APSIM and DSSAT | | | | | May 2020 | |
| 6.4 Economic benefit analysis of sorghum under different fertilizer management application performed | | | | | | Statistical and modelling analysis | | | | | May 2020 | |
| 6.5 Technical reports and conference paper prepared | | | | | | Presentation at international conference | | | | | Feb. 2020 | |
| 6.6 Manuscript on Improving grain sorghum productivity in water-limited environments under climate change | | | | | | Field Crops Research Journal (submitted) | | | | | Dec. 2019 | |
| 6.7 Finalization of the West Africa Handbook in collaboration with the co-authors as a team. | | | | | | Draft handbook | | | | | Oct. 2019 | |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | |
| Domain | | | Indicator | | | | | Metrics/Scale | | | | |
| 7.1 Productivity | | | Crop productivity, coefficient of variability. | | | | | kg biomass (yield, fodder)/ha/season at farm level. Number of crops grown per year on a given plot (by crop). Plant population density (seeds/ha/season or seeds/ha/year) at farm level | | | | |
| 7.2 Environmental | | | Soil chemical properties, Soil fertility. | | | | | NPK, pH, OM at plot level | | | | |
| 7.3 Economic | | | Profitability, variability of profitability | | | | | Net income ($/crop/ha/season)  Farm-level cost-benefit analysis to determine the best fertilizer scenarios | | | | |
| 7.4 Social | | | Equity | | | | | Ranking of technologies/treatments Farmers perceptions of technologies at farm level determined during farmers field days and also through analytical and modelling approaches at plot level | | | | |
| 7.5 Human | | | Nutrition | | | | | Sorghum grain for household food production (calories/ha/year)  Number of new practices being tested or % of farmers intending to take on the new practice | | | | |
|  | | | | | | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 8. How will scaling be achieved? | | | | | |
| Scaling is done through local NGOs AMEDD and FENABE. Identification of various agronomic packages is key for scaling strategies. The use of modelling approach helps to identify the potential yield advantages of varieties over a long-term climate change. | | | | | |
|  | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | |
| The activities in the current proposal are linked through the farming system concept. Nutrient use efficiencies on crop and crop productivity are linked to activity MA1112-19. Environmental and social benefits of sorghum varieties in different ecologies are linked to watershed activities. | | | | | |
|  | | | | | |
| 10. Custom indicators: | | | | | |
| * Number of farmers attending farmers field days and participating in the evaluation of best sorghum trials * Number and types of scenarios developed under different agro-ecologies that determine increased productivity and resilience to climate shocks * Handbook chapter * Journal manuscript | | | | | |
|  | | | | | |
| 11. Impact-based summary matrix | | | | | |
| 11.1 What is the development challenge you are addressing?  The research sites are constrained by soil fertility and productivity remains low. In addition, water is very limited which results in food and feed shortages. These activities intend to address this issue through nutrient use efficiency practices under changing water stress conditions. Prediction of long-term climate variability on crop productivity and environmental benefits. | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Local NGOs, farmers, extension agents, researchers and land use and climate change practitioners. | | | | | |
|  | | | | | |
| 12. Budget (US$) | | | | | |
| Outcome/Output/  Activity | Sub-activity | **Budget line item** | **ICRISAT** | **AMEDD** |  |
| Outcome 1/Output 1/ Activity 1 | MA1111-19 | Personnel | 27,500 | 2,500 |  |
| Services | 10,500 | 1,000 |  |
| Supplies | 4,500 | 3,000 |  |
| Capital |  |  |  |
| Travel | 5,500 | 1,500 |  |
| Overhead (17%) | 8,160 | 1,360 |  |
|  |  | **Total** | **56,160** | **9,360** |  |
| **Total** |  |  |  |  | **65,520** |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | **Week** | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Training/Conf. participation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field experimentation/Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Contribution/ finalizing West Africa Handbook Chapter |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Technology dissemination via field day |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Model evaluation setup, analysis and strategic insights |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2019 Data analysis & Tech. reports |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Development of extension materials on improved Sorghum husbandry |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Development of manuscripts & submission |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainable intensified Crop-Livestock systems linked to markets. | | | | | | | | | | | |
| a. Output 1.1 | | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | |
| b. Activity 1.1.1 | | | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | |
| c. Sub-activity MA1112-19 | | | | | Understanding soil fertility management in cereal cropping systems in southern Mali. | | | | | | |
|  | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | |
| Birhanu Zemadim | | | ICRISAT | | | Activity leader | | | | | |
| Bouba Traore | | | ICRISAT | | | Farming systems scientist | | | | | |
| Felix Badolo | | | ICRISAT | | | Economic analysis | | | | | |
|  | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | |
| Name | | Institute | | | | | | Degree | Start | | End |
| Moumini Guindo | | Ecole doctorale des sciences et technologies du Mali (EDSTM) | | | | | | PhD | Jan. 2019 | | Dec. 2021 |
| Hama Kassé | | IPR-IFRA | | | | | | MSc/BSc | May 2019 | | May 2020 |
|  | | | | | | | | | | | |
| f. Location(s) | Koutiala | | | | | | | | | | |
|  | | | | | | | | | | | |
| g. Start | April 2017 | | | | | | | | | | |
|  | | | | | | | | | | | |
| h. End | March 2021 | | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | |
| In Mali since decades, stakeholders including farm households and scientists are increasingly recognizing soil nutrient depletion as one of the major constraints to sustainable agricultural development. Farming systems in the country are diverse due to different climate, soils and production goals. Many complex factors are influencing the nutrient dynamics that include nutrient management, regeneration and plant protection, livestock integration, soil and water conservation, biodiversity, agricultural policies and marketing structures. These factors either alone or combined can enhance or result in soil nutrient depletion.  Farm households are confronted with deteriorating price relations between farm inputs and outputs resulting in net exploitation of soil nutrients. Due to the prevailing poverty condition, farm households have limited options for investments in nutrient-adding or nutrient-saving technologies. Nowadays, this situation is worsening due to climate change and variability. Climate-smart technologies such as organic manure use and micro-dosing application have been implemented by various actors to deal with soil nutrient depletion and climate change. Yet, there are unanswered questions about the durability of this system.  In this study, we will use NUTMON (NUTrient MONitoring) to target soil nutrient management across different farm typologies. It will include financial balancing under the current farming systems as well as the application of Climate-Smart Technologies (CST) such as micro-dosing of mineral and organic fertilizer. Composting technology using cotton stem will be developed and evaluated by field application strategies. The NUTMON Model will be used at plot scale with an extension to the household taking into account population expenses and assets from outside. In the end, NUTMON will be used as a decision support tool and will be presented to the extension workers as well as to policymakers. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 2. Objectives: Optimization of nutrients flow and determining the efficiency of fertility management options | | | | | | | | | | | |
| 2.1 Assessing nutrient flows and nutrient balance under different soil fertility conditions | | | | | | | | | | | |
| 2.2 Exploring and testing promising nutrient management options | | | | | | | | | | | |
| 2.3 Testing strategies for composting and improving nutrient use efficiency for sustainable soil fertility management | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | |
| 3.1 What are the determinants of soil fertility and nutrient balance under different soil fertility management conditions? | | | | | | | | | | | |
| 3.2 What are the farmers’ adaptation options with regards to soil nutrient depletion? To what extent does livestock corralling contribute to increased soil fertility? What is the optimum deposit of nutrients under livestock corralling system? | | | | | | | | | | | |
| 3.3 How can cotton stems be used as a source of diversification for composting? What are the major constraints of producing compost with cotton stems? | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | |
| 4.1 For mapping nutrient flow and balance, an exhaustive diagnostic will be conducted at farm scale involving 45 farmers from the three AR villages (Zanzoni, Sirakele and N’golonianasso) of Koutiala. The goal of the diagnostic phase is to analyze the current situation regarding soil nutrient depletion and economic performance. Soil samples as well as manure from different sources such as farmyard, cattle, compost etc. will be collected across different farm types (typologies). Nutrient content will be quantified through laboratory analysis and results will be used for running the NUTMON toolbox. Flows will be expressed in kilograms of N, P and K (nutrient flows), but also in monetary values (financial flows). The quantified nutrient flows explain which activities within a farm are nutrient consuming and which are accumulating nutrients, and how and when nutrients flow from one activity to another takes place. The quantifying financial flows will give insight into the profitability of activities (crops, livestock, fishponds, compost heap and pits) and labor demands. | | | | | | | | | | | |
| 4.2 Exploration of promising nutrient management adaptation options will be done at farm level together with the farmer, and a process of participatory technology development will be organized to identify technologies to address the problems identified in the diagnostic (see 4.1). Based on the diagnosis, farmers will be asked to prioritize technologies, which will be tested on-farm. In this phase, knowledge and experiences are used from both science-based and local knowledge systems to arrive at the most appropriate and consensus solutions.  For quantifying crop-livestock interaction, the effect of the cattle parking system will be explored with 6 agro-pastoralist in the village of Zanzoni and Sirakele. A total of 20 cattle will be parked respectively for 3, 7, 10 and 15 nights in a 150 m2 (15 m x 10 m) enclosure and will be used as the experimental plot. Nutrient content of cattle manure and urine will be analyzed and effect on two planting density (0.75 m\*0.30 m and 0.75 m\*0.20 m) of dual-purpose sorghum will be determined. | | | | | | | | | | | |
| 4.3 From January to April 2019 heap compost was produced comparing two composting (1 t cotton stem + 200 kg cattle manure, 2 t cotton stem + 200 kg cattle manure) method with cotton stems. During the rainy season, field experimentation with the two compost treatments will be conducted at farmer field as well as in the technology park of Koutiala. Each farmer will be experimenting with one of the two composting treatments. Dual-purpose sorghum variety validated by Africa RISING in 2017 and 2018 will be used across all the experiment including in farmers’ fields.  Compost produced will be used as a micro-dosing system. The treatments include the following:   1. Zero (no application of compost and no mineral fertilizer) 2. Control practice 1 (recommended mineral fertilizer) 3. Control practice 2 (recommended mineral fertilizer micro-dosing) 4. Compost practice (farmers compost without cotton stem with spreading technique) and no fertilizer 5. Compost practice (farmers compost without cotton stem with micro-dosing technique) and no fertilizer 6. Compost practice (farmers compost without cotton stem with spreading technique) + Recommended mineral fertilizer 7. Compost practice (farmers compost without cotton stem with micro-dosing technique) + Recommended mineral fertilizer 8. Compost 1 with cotton stem (micro-dosing) + Recommended mineral fertilizer 9. Compost 1 with cotton stem (spreading)+ Recommended mineral fertilizer 10. Compost 2 with cotton stem (spreading) + Recommended mineral fertilizer 11. Compost 2 with cotton stem (micro-dosing) + Recommended mineral fertilizer   Recommended mineral fertilizer for sorghum is: 34 kg of N ha-1, 34 kg of P ha-1 and 34 kg of K ha-1). | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | Responsibility/ Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes (4 yrs) | | | | | | | | |  | | |
| 5.1 Resource inventory, farm characterization, nutrient flow | | | | | | | | | ICRISAT | | |
| 5.2 Soil physiochemical analysis, crop grain and biomass yield, etc. | | | | | | | | | ICRISAT | | |
| 5.4 For chemical characterization: pH (1: 2.5 H2O), total organic carbon, total NPK, calcium, magnesium, C/N ratio will be determined in the laboratory at maturation time of the compost | | | | | | | | | ICRISAT | | |
| 5.5 Sorghum yield across treatments; labor; economic costs, etc. | | | | | | | | | ICRISAT | | |
|  | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | Delivery date | |
| 6.1 Household-level nutrient flow data | | | | | | | | Report included in the full report | | Mar. 2020 | |
| 6.2 Model result on nutrient flow characterized across farm typologies | | | | | | | | Report included in the full report | | Mar. 2020 | |
| 6.3 Composting technology developed based on cotton stems; efficiency of compost application demonstrated | | | | | | | | Report included in the full report | | Dec. 2019 | |
| 6.4 Integrated soil fertility management practices under different input and nutrient flow conditions determined | | | | | | | | Journal article (published) | | Jul. 2021 | |
| 6.5 Finalization of the West Africa Handbook in collaboration with the co-authors as a team: Technology 6: Compost making. Chapter 3: Integrated soil fertility management | | | | | | | | Technology handbook | | Dec. 2019 | |
|  | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | |
| Domain | | | | Indicator | | | Metrics/Scale | | | | |
| 7.1 Productivity | | | | Crop Productivity, Variability of production | | | Yield at plot level, above-ground biomass (t/ha) at farm level | | | | |
| 7.2 Environmental | | | | Soil chemical quality  Soil nutrients | | | NPK, pH, total organic matter at farm level | | | | |
| 7.3 Economic | | | | Profitability, variability of profitability | | | Net income at farm level, % of production sold (by crop, animal product), % of total income from agriculture at farm level | | | | |
| 7.4 Social | | | | Gender Equity | | | Farmer group work, access to information, % of labor involved in the activity, ranking of technologies at farm level, Literacy and numeracy of adults, % of men and women literate at household level | | | | |
| 7.5 Human | | | | Nutrition | | | Diversity of crops grown (% of all land) disaggregated by consumption versus sale at field level, capacity to learn | | | | |
|  | | | | | | | | | | | |

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| --- |
| 8. How will scaling be achieved? |
| Developed technologies will be made available for scaling through training of farmers in different villages and for extension workers. Reports, technical documents and scientific papers developed with the activity will help to disseminate the technology widely. |
|  |
| 9. How are the activities in this protocol linked to those of others? |
| This is farming system research including soil fertility management, crop management, socioeconomic analysis. Results can be used by other activities for further understanding of nutrient management under different soil fertility condition. It is therefore linked to MA1213-19 and MA1111-19. |
|  |
| 10. Custom indicators |
| * Two training sessions will be organized in each of three villages * Technology handbook * Article submitted |
|  |
| 11. Impact-based summary matrix |
| 11.1 What is the development challenge you are addressing?  This activity will address nutrient management issues under low soil fertility management as well as evaluation of the contribution of livestock corralling system on improving soil fertility management. |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Extension agents, farmers and NGO. |

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| 12. Budget (US$) | | | | | |
| Outcome/Output/Activity | Sub-activity | **Budget line item** | **ICRISAT** |  |  |
| Outcome 1/Output 1/ Activity 1 | MA1112-19 | Personnel | 22,500 |  |  |
| Services | 8,500 |  |  |
| Supplies | 3,500 |  |  |
| Capital |  |  |  |
| Travel | 4,500 |  |  |
| Overhead (17%) | 6,630 |  |  |
|  |  | **Total** | **45,630** |  |  |

13. Gantt Chart

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| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | |
| **Jun** | | | | **Jul** | | | | **Aug** | | | | **Sep** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Meeting with farmer for survey |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field (identification, planting) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Crop growth measurement |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Crop harvest (biomass and grain) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Soil sampling and analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and reporting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | |
| a. Output 1.1 | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | |
| b. Activity 1.1.1 | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | |
| c. Sub-activity MA1113-19 | | Testing adaptation of dual purposes sorghum hybrids in Mali to diversify options for crop-livestock integration. | | | | | | |
|  | | | | | | | | |
| d. Research team | | | | | | | | |
| Name | | Institution | Role | | | | | |
| Baloua Nebie | | ICRISAT | Activity leader | | | | | |
| Felix Badolo | | ICRISAT | Economic analysis | | | | | |
| Mamourou Sidibe | | ICRISAT | Field activities | | | | | |
| Abdoulaye Diallo | | IER | Field activities | | | | | |
| Birhanu Zemadim | | ICRISAT | Activity coordinator | | | | | |
| Bougouna Sogoba | | AMEDD | Farmers’ mobilization | | | | | |
| Mahamadou Dicko | | AMEDD | Data collection, Farmers’ mobilization | | | | | |
| Madina Diancoumba | | ICRISAT | Research Scholar, modeling specialist | | | | | |
| Nadine Worou | | ICRISAT | Modeling | | | | | |
|  | | | | | | | | |
| e. Student(s) | | | | | | | | |
| Name | Institute | | Degree | | | Start | | End |
| Togo Aly | IPR/IFRA Katibougou | | MSC | | | Jul. 2019 | | Feb. 2020 |
|  | | | | | | | | |
| f. Location(s) | Bougouni and Koutiala | | | | | | | |
|  | | | | | | | | |
| g. Start | June 2019 | | | | | | | |
|  | | | | | | | | |
| h. End | March 2021 | | | | | | | |
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| 1. Justification | | | | | | | | |
| In Mali, sorghum and millet are used by farmers as staple food, especially in the rural areas. With the continual increase of livestock coupled with the diminishing natural pastures, crop residues are playing an important role in animal feeding, especially during the dry season. Most farmers are using landrace residues as fodder but the quantity and especially the quality of this feed is limited/poor. The stems are tall and hard due to high lignin content which negatively influences fodder digestibility and animals are only able to eat the top of the stem. New varieties of sorghum (such as Soubatimi, Tiandougoucoura, Peke) combining grain yield (~2t/ha), fodder yield (15 to 20 t/ha for fresh stover) and quality (green leaves until grain maturity) were developed (CEDEAO-UEMOA-CILSS, 2016[[66]](#footnote-66)). These varieties were tested in the Africa RISING technology parks as well as on-farm in Mali and farmers are now growing them for both grains (for household consumption) and fodder (livestock feeding). These varieties showed high grain yield over the landraces (Africa RISING 2019 interim report and publication[[67]](#footnote-67);[[68]](#footnote-68)) in each zone and stover quality is also higher given their stay-green trait and also the low lignin of the stem.  The present activity “Evaluation of dual-purposes sorghum hybrids” is based on the evidence highlighted from the activities above and also on the hybrids yield advantage which was reported to be up to 30 % compared to the local variety across different production conditions in farmers’ field in Mali (Rattunde *et al*., 2013[[69]](#footnote-69)). The new hybrids proposed for this activity have been selected from a set of 34 based on grain yield and farmers’ preferences in different zones. They showed at least 10% of grain yield advantage compared to Fadda (released hybrid) and at least 20% compared to Tieble (stable farmers preferred variety). Testing dual-purpose hybrids will provide more options to farmers by keeping stover quality and increasing grains yields as compared to the OPVs dual-purpose sorghums. The activity will be implemented in four technology parks in Mali with 4 new hybrids compared to Fadda and a local variety. Additionally, the proposed activity consists of delineating the optimum production region of dual-purpose sorghum varieties, identifying the major water stress scenarios affecting crop growth and development and identifying management options for these scenarios that will sustainably optimize production. | | | | | | | | |
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| 2. Objectives | | | | | | | | |
| 2.1 Identify dual-purpose sorghum hybrids adapted to Africa RISING target zones in Mali and delineate the production area of dual-purpose sorghum hybrids. | | | | | | | | |
| 2.2 Identify farmers preferred sorghum hybrids for future scaling in the target zones. | | | | | | | | |
| 2.3 Assess economic advantage/disadvantage of new hybrids compared to local varieties. | | | | | | | | |
| 2.4 Identify the major stress scenarios that could affect dual-purpose sorghum during the growing period | | | | | | | | |
|  | | | | | | | | |
| 3. Research questions | | | | | | | | |
| 3.1 Which of the dual-purpose sorghum hybrids adapt well to Africa RISING targeted zones and beyond? | | | | | | | | |
| 3.2 Are there stable hybrids for the two Africa RISING zones in Mali, adapted to the environmental conditions and preferred by farmers or specific material is needed for each zone? | | | | | | | | |
| 3.3 What is the relation between farmers’ preferences and agronomic traits? | | | | | | | | |
| 3.4 What economic advantage have hybrids compared to farmers’ best variety in each zone? | | | | | | | | |
|  | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | |
| Four new dual-purpose sorghum hybrids will be evaluated in the Africa RISING technology parks in Mali (4 locations). In each location, the trial will be implemented following an Alpha lattice design with 3 replications, 10 rows of 5 m per plot. The distances between the rows will be 75 cm and between the hills, 30 cm. DAP (100 kg/ha) and Urea (50 kg/ha) will be applied after respectively 15 days and 40 to 50 days after sowing. To enable comparison between the improved variety and the local one in the target zone, the farmers’ preferred variety will be included as a local check in all the trials. The field conditions, agronomic data and farmers’ preferences will be recorded at the appropriate times following the implementation protocol. Farmers’ evaluation will be done at grain maturity, a few days before harvesting. | | | | | | | | |
| 4.1 Preparation of field protocols and seed packs for the trials | | | | | | | | |
| 4.2 Training of technicians on trial implementation | | | | | | | | |
| 4.3 Farmers evaluation (preferences) of hybrids in each technology park | | | | | | | | |
| 4.4 Data collection and analysis following the protocol | | | | | | | | |
| 4.5 Variety parametrization and simulation setup and runs:The sorghum crop-growth model in Agricultural Production Systems Simulator (APSIM) and DSSAT models will be used to perform simulations. The models will be provided with inputs of meteorological dataset (daily rainfall, maximum and minimum temperatures and solar radiation), soil data, crop parameters and crop management options. Once the model set-up evaluated, the APSIM and DSSAT models will be run across the sorghum production region of Mali over 15 minimum years (ideally 30 years) to identify optimum production bands of dual-purpose sorghum and the major stress scenarios impacting its performance in those bands. | | | | | | | | |
| 4.6 Testing options for increasing productivity:The management practice data that will be obtained, will serve to conduct a sensitivity analysis on a range of management practices to sensibly reflect the agricultural environments through APSIM and DSSAT models. Different fertilizer application rates and times and different soil types will be tested. Different sowing periods can also be defined based on collected data and the length of the growing period of each study site. | | | | | | | | |
|  | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | Responsibility/Institute | |
| Is the collected data part of a multi-year experiment/trial? Yes (2 yrs) | | | | | | |  | |
| 5.1 Field characterization (soil type, cropping system, etc.) plus rainfall and GPS data | | | | | | | Mahamadou Dicko, Abdoulaye Tangara, Mamourou Sidibe/AMEDD | |
| 5.2 Farmers preferences for varieties | | | | | | | Baloua Nebie/ICRISAT & A. Diallo/IER | |
| 5.3 Grain yield and stover yields | | | | | | | Baloua Nebie/ICRISAT | |
| 5.4 Stover biochemical composition | | | | | | | Baloua Nebie/ICRISAT | |
| 5.5 Plot survey (yields and input costs) | | | | | | | Felix Badolo/ICRISAT | |
| 5.6 Map of trial locations on-farm/parks | | | | | | | Madina Diancoumba & Baloua Nebie/ICRISAT | |
| 5.7 Parametrization of APSIM and DSSAT | | | | | | | Madina Diancoumba & Nadine Worou/ICRISAT | |
|  | | | | | | | | |
| 6. Milestones | | | | | | | | |
| Deliverables | | | | | Means of verification | | | Delivery date |
| 6.1 Finalization of the West Africa Handbook in collaboration with the co-authors as a team: (Sorghum hybrids) under chapter 1 | | | | | WA technology handbook | | | Aug. 2019 |
| 6.2 Finalization of the technology handbook contribution in collaboration with the co-authors as a team: (Dual-purpose sorghum) under chapter 1 | | | | | WA technology handbook | | | Aug. 2019 |
| 6.3 Scientific article submitted (with 2-year data)  Agronomic and economic values of dual-purpose sorghum varieties in Bougouni and Koutiala zones in Mali. Experimental Agriculture. | | | | | Article published with the title: Agronomic and economic values of dual-purpose sorghum varieties in Bougouni and Koutiala zones in Mali. Link provided in the Journal of Experimental Agriculture. | | | Nov. 2019 |
| 6.4 Report on farmers perception of varieties | | | | | Report included in the full report | | | Mar. 2020 |
|  | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | |
| Domain | Indicator | | | Metrics/Scale | | | | |
| 7.1 Productivity | Crop productivity | | | Grain yield & stover yield in kg/ha at plot level | | | | |
| 7.2 Environmental | Soil Chemical Properties  Soil nutrients | | | NPK, pH, total organic matter at farm level | | | | |
| 7.3 Economic | Profitability  Variability of profitability | | | Net income at farm level  % of production sold (by crop) at farm level  % of total income from agriculture at farm level | | | | |
| 7.4 Social | Gender Equity | | | Farmers’ rating of technology at farm level | | | | |
| 7.5 Human | Nutrition  Food security | | | Micronutrient (Fe/Zn) production (g/ha) at plot level  Availability of food at household level | | | | |
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| 8. How will scaling be achieved? | | | | | |
| The trials will be implemented in the technology parks located in Koutiala (M’Pessoba and N’golonianasso) and Koutiala (Madina and Flola) in Mali, which are accessible to exposed to farmers and other end-users such as processors and seed traders. During the evaluations of the trials in the technology parks, the best hybrids identified by farmers will be released later for seed production and commercialization in the different zones by farmers’ organizations and local private seed companies. Local seed cooperatives and seed companies, extensions services (Agriculture services and NGOs) and rural radios will be also associated to the field visit to ensure seed availability when a given hybrid has been identified and also that a minimum of 2,000 farmers is reached. | | | | | |
|  | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | |
| This activity is focused on yield-increasing and crop-livestock integration (dual-purpose sorghum). It is therefore linked to MA1121-19: Efficient feed utilization through improved feed troughs, MA1122-19: Fodder production for improved ruminant productivity, and MA1131-19: Risk management and informed decision making towards sustainable intensification of crop-livestock systems | | | | | |
|  | | | | | |
| 10. Custom indicators | | | | | |
| * Number of improved technologies exposed to farmers’ appreciation (target = 4) * Number of stakeholders reached with innovative approaches/methods (target = 100, FtF Indicator 1.4) * Number of beneficiaries trained (at multiple scales: farmer, extension, researchers, students, other stakeholders, policymakers (target = 50, FtF Indicator 2.4) * Number of farmers evaluating dual-purpose hybrid sorghum (target = 30, FTF Indicator 2.10 modified) | | | | | |
|  | | | | | |
| 11. Impact-based summary matrix | | | | | |
| 11.1 What is the development challenge you are addressing?  Sorghum producers still have low yields and most of them use local varieties since they are not adequately exposed to improved varieties and hybrids. The availability of animals feed continues to be a challenging issue and crops residues are the most used during the dry season. Farmers are now looking for cultivars with high grain yield and grain quality for the household nutrition as well as quality stover for livestock feeding. | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The action proposed targets male and female farmers for their food security and also animal feeding. This category of farmers are sorghum growers but also have animals which are nourished during the off-season with crop residues. Men are often in charge of big animals (cows and donkey) and in certain zone small ruminants too. Women are in general managing small ruminants (sheep, goals). | | | | | |
|  | | | | | |
| 12. Budget (US$) | | | | | |
| Outcome/Output/Activity | Sub-activity | **Budget line item** | **ICRISAT** |  |  |
| Outcome 1/Output 1/ Activity 1 | MA1113-19 | Personnel | 34,500 |  |  |
| Services | 8,500 |  |  |
| Supplies | 5,500 |  |  |
| Capital |  |  |  |
| Travel | 6,500 |  |  |
| Overhead (17%) | 9,350 |  |  |
|  |  | **Total** | **64,350** |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Technology handbooks finalizing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Seed and fertilizer preparation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training on postharvest management |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data cleaning and analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Scientific article writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mapping of trials locations on-farm/park |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report on farmers perception on hybrids sorghum |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Variety parametrization with APSIM and DSSAT |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Global reporting on the trial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | | | | | |
| a. Output 1.1 | | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | | | | |
| b. Activity 1.1.1 | | | | | Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production. | | | | | | | | | | | | |
| c. Sub-activity MA1114-19 | | | | | Evaluating and disseminating promising technologies tested in 2018 for performance and profitability to intensify vegetable production under rainfed and dry seasons. | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | | | |
| Name | | | | | Institution | | | Role | | | | | | | | | |
| Jean Baptiste Tignegre | | | | | WorldVeg | | | Sub-activity leader: design protocols; data analysis and report writing | | | | | | | | | |
| Wubetu Legesse | | | | | WorldVeg | | | Data analysis of pests and diseases | | | | | | | | | |
| Edoh Ognakossan Kukom | | | | | WorldVeg | | | Implementing postharvest and processing training | | | | | | | | | |
| Alpha Sidy Traore | | | | | WorldVeg | | | Supervise fieldwork and collect data | | | | | | | | | |
| Gundula Fischer | | | | | IITA | | | Design and implement gender studies on vegetable production | | | | | | | | | |
| Felix Badolo | | | | | ICRISAT | | | Perform comparative cost-benefit analysis over seasons | | | | | | | | | |
| Mahamadou Dicko | | | | | AMEDD | | | Community mobilization and technology dissemination in Koutiala | | | | | | | | | |
| Sidibe Toumani | | | | | FENABE | | | Community mobilization and technology dissemination in Bougouni | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| e. Student (s) | | | | | | | | | | | | | | | | | |
| Name | | Institute | | | | | | | | Degree | | | | Start | | End | |
| Moussa Kanoute | | University of Ouagadougou, Burkina Faso | | | | | | | | PhD | | | | 2019 | | 2021 | |
| Raki Diallo | | University of Bamako, Mali | | | | | | | | PhD | | | | 2019 | | 2021 | |
|  | | | | | | | | | | | | | | | | | |
| f. Location(s) | | Koutiala and Bougouni | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| g. Start | | April 2017 | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| h. End | | March 2021 | | | | | | | | | | | | | | | |
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| 1. Justification | | | | | | | | | | | | | | | | | |
| The dissemination of vegetable technologies (production, post-harvest and processing for household farmers) can improve production, reduce post-harvest losses and generate more income. Participatory evaluation and diffusion of new promising vegetable cultivars will be carried out to deliver high value, multiple disease-resistant and nutrient-dense vegetable cultivars. Demonstration on adapted storage prototypes and processing technologies will be carried out in the technology parks/lead hubs to reduce postharvest losses, avail healthy products and improve income. Vegetable mono-cropping will be implemented with the dissemination of farmers’ preferred vegetable varieties and species. Twelve farmers (households) in the intervention villages of Bougouni and Koutiala districts (total of 108) will be selected to participate in testing and diffusion of the four most popular vegetable crops (pepper, tomato, African eggplant, and cowpea). In each of the target intervention villages, improved/validated vegetable varieties and local varieties will be compared and disseminated across subsets of 10 households per village (validated or improved varieties vs. adapted local variety). | | | | | | | | | | | | | | | | | |
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| 2. Objectives | | | | | | | | | | | | | | | | | |
| 2.1 Evaluate and disseminate new varieties of farmers’ and market preferred vegetable species under rainfed and irrigated conditions through farmer participatory approaches. | | | | | | | | | | | | | | | | | |
| 2.2 Promote information and knowledge exchange among farmers. | | | | | | | | | | | | | | | | | |
| 2.3 Train farmers on good agricultural practices in vegetable garden techniques, postharvest and processing techniques. | | | | | | | | | | | | | | | | | |
| 2.4 Determine the effects of home gardens on food security and profitability of vegetable varieties with different profiles (fruit, Vitamin A-containing) in the dry season. | | | | | | | | | | | | | | | | | |
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| 3. Research questions/hypotheses | | | | | | | | | | | | | | | | | |
| 3.1 Leaf and/or fruit yield, pest and disease resistances under adapted storage condition of improved varieties vegetable varieties will improve significantly as compared to those of local varieties under irrigated and rainfed conditions | | | | | | | | | | | | | | | | | |
| 3.2 The food diversity score of sack garden beneficiary is improved | | | | | | | | | | | | | | | | | |
| 3.3 The preference of vegetable species and varieties is gender-neutral | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 4. Procedures | | | | | | | | | | | | | | | | | |
| Sub-activity MA1114-1901: Conduct indigenous and exotic vegetable variety trials & demonstrations in the dry season (September 2019). | | | | | | | | | | | | | | | | | |
| (This sub-activity was conducted last year but needs to avail two more years’ data sets  This sub-activity integrates production, disease assessment and control, nutrition, gender equity and economic research and scaling components.  Ninety farmers in the communities of Bougouni and Koutiala will be implementing variety demonstrations at the technology parks and on farmers' fields to test or disseminate rainfed tomato, onion, African eggplant and vegetable cowpea to select high-yielding and disease-resistant varieties. The field design will be randomized complete blocks with 4 replicates in the technology parks combined across 2 locations (Bougouni, Koutiala); non-lead farmers will test a single replicate of the above varieties. Farmers will plant at least 3 improved varieties of each species including farmers' variety as control variety. The villages of Dieba, Flola, Madina and Sibirila (Bougouni District), Zanzoni M’pessoba, N’Golonianasso, Nampossela and Sirakele (Koutiala district) will host the trials and demonstration fields. The technology parks will host the replicated trials.  The capacity of vegetable farmers will be improved with training on vegetable gardens. In addition, a nursery of 26 new tomato and 14 new pepper varieties will be conducted in the lead hubs to enable preliminary participatory selection by farmers with regards to diseases and yield performance, market, food and feed suitability. Two field days will be organized at transplanting and maturing stages to document production practices and farmers' preferences for improved varieties. Participatory testing and diffusion of promising new vegetable cultivars will be carried out to deliver high value, multiple disease-resistant cultivars in the rainy season. Data will be collected for leaf and fresh fruits yield, input & labor costs, varietal performances to plant diseases, farmers’ perceptions and climatic data (annual rainfalls). Data will also be collected on dry season trials and demonstrations. A survey will be implemented to document gender preferences for onion and vegetable cowpea. | | | | | | | | | | | | | | | | | |
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| Sub-activity MA1114-1902: Test and demonstrate vegetable performance using sack gardens to enable more access to vegetables and generate income for women farmers in the dry season *(November 2019)*. | | | | | | | | | | | | | | | | | |
| (This activity is new and adds value to previous research results such as access to affordable and diverse vegetable production and consumption by more beneficiaries).  The deployment of sack gardens aims at enabling vegetable production by women with no access to land or a reliable water source for normal gardening. It involves recycled fertilizer bags as containers filled with soil and compost serving as plant substrate. It promotes space and water use efficiency and implies that a diverse range of legumes species can be grown in a confined space. Three to four cycles of production are possible annually. In the house, it appears as a source of food and ornamentals. The access is easy for all social categories in rural areas and urban and peri-urban farmers. A hundred farmers in two districts (Bougouni and Koutiala) will test tomato, onion, Amaranth, cabbage, carrot and vegetable cowpea, using 50kg-content recycled fertilizer sacks in the dry season. Fifty farmers in each district will plant 25-30 vegetable seedlings of amaranth, African eggplant, tomato, cabbage, onion carrot and vegetable cowpea will be planted on the open top of the sacks (horizontal position).  The field design will be randomized blocks with 4 replicates in two technology parks across 2 locations (Bougouni, Koutiala); non-lead farmers will test a single replicate of tomato, Amaranth, African eggplant, onion, cabbage, carrot, vegetable cowpea.  Data will be collected for leafy and fresh fruits, input and labor costs, varietal performances to plant diseases, plant turgor retention, leaf index area, soil moisture, farmers’ perceptions on varieties (tomato, Amaranth, African eggplant, onion, cabbage, vegetable cowpea, etc.) and sack gardening. The effect of sack gardening on food security for households will be assessed. | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | | Responsibility/Institute | | | | | |
| 5.1 Days to 50 % flowering | | | | | | | | | | | | WorldVeg | | | | | |
| 5.2 Number of plants bearing fruits per plot; fruit, bulbs and leaf yields (kg/ha) | | | | | | | | | | | | WorldVeg | | | | | |
| 5.3 Disease & pest incidence (fungi, bacteria, virus, whiteflies, thrips, aphids, mites), new resistance sources | | | | | | | | | | | | WorldVeg | | | | | |
| 5.4 Daily temperatures & humidity of ZECC, shelf-life duration (days), weight loss, quality parameters (TSS, acidity and color), etc. | | | | | | | | | | | | WorldVeg | | | | | |
| 5.5 Temperature & relative humidity, drying rate, moisture content and color | | | | | | | | | | | | WorldVeg | | | | | |
| 5.6 Gender preferences for vegetable varieties | | | | | | | | | | | | IITA | | | | | |
| 5.7 Farmers’ perception on sack gardening and its effect on food security | | | | | | | | | | | | ICRISAT | | | | | |
| 5.9 Submit publication of two articles on sustainable intensification of vegetables in Mali and Ghana | | | | | | | | | | | | WorldVeg | | | | | |
| 5.10 Book chapter for vegetable production sections in Mali and Ghana completed. | | | | | | | | | | | | WorldVeg | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | | | Delivery date | | | | |
| 6.1 High performing vegetable varieties with farmers’ preferred traits identified | | | | | | Project interim & full reports | | | | | | | May 2020 | | | | |
| 6.2 New disease-resistant tomato & pepper varieties identified in Bougouni & Koutiala districts | | | | | | Project interim & full reports | | | | | | | May 2020 | | | | |
| 6.3 Major vegetable diseases identified for Bougouni & Koutiala districts | | | | | | Project interim & full reports | | | | | | | May 2020 | | | | |
| 6. Field days & participatory variety selection organized | | | | | | Project report with a list of participants disaggregated by sex | | | | | | | Mar. 2020 | | | | |
| 6.5 A report on farmers training and trial establishment | | | | | | Report included in the full report | | | | | | | Sep. 2020 | | | | |
| 6.6 Database on vegetables | | | | | | Uploaded on Dataverse | | | | | | | Sep. 2020 | | | | |
| 6.7 Food security implemented | | | | | | Project reports | | | | | | | Sep. 2020 | | | | |
| 6.8 Gender preference for onion & vegetable cowpea varieties established | | | | | | Project reports | | | | | | | Sep. 2020 | | | | |
| 6.9 Finalization of the West Africa Handbook chapter on vegetable production for Mali and Ghana in collaboration with the co-authors as a team | | | | | | Handbook chapter submitted | | | | | | | Nov. 2019 | | | | |
| 7.0 publication of two articles on sustainable intensification of vegetables in Mali and Ghana | | | | | | Articles submitted to the journal of Experimental Agriculture | | | | | | | Jun. 2020 | | | | |
|  | | | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | | | | | | |
| Domain | | | Indicator | | | | Metrics/Scale | | | | | | | | | | |
| 7.1 Productivity | | | Crop productivity | | | | Fruit yield and fodder yield (kg/ha) at farm level | | | | | | | | | | |
| 7.2 Environmental | | | Plant biodiversity | | | | Number of species & varieties at field/plot level | | | | | | | | | | |
| 7.3 Economic | | | Profitability | | | | Net income/ha at plot and farm level | | | | | | | | | | |
| 7.4 Social | | | Gender equity | | | | Access to land, market & preference for varieties at household level | | | | | | | | | | |
| 7.5 Human | | | Nutrition  Collective action | | | | Nutrient content in tomato & onion under different fertilizer dose application at farm level  Capacity to experiment at community/landscape (% farmers experimenting) | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | | | |
| Scaling activities in 2019-2020 will include a partnership with development partners (AMEDD, FENABE, Women farmers’ associations in Koutiala and Bougouni, National Agricultural Research Stations (NARS)). Knowledge transfer and scaling strategies will include the establishment of research-for-development plots to demonstrate technologies, participatory and joint learning approaches for variety selection in the community-based technology parks as well as farm fields, development by WorldVeg of training of trainers and hands-on training for farmers. | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | | | |
| This activity is an integrated approach that involves nutrition, production and economic interventions. It is linked to post-harvest sub-activity MA2221-19. | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | | | |
| * Number of farmers for whom the technology is affordable * Number of farmers for whom the technology is available locally | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Low access to quality seeds and improved varieties, (ii) high pressure of diseases & pests no effective control methods and uses of prohibited pesticides (iii) high postharvest losses by household farmers due to low access to affordable storage facilities, (iv) high rates of malnutrition prevailing for women and infants due to low consumption of vegetables (iv) low access to land and markets by women, (v) weak linkage to vegetable markets | | | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The targeted audience is farmers, extension agents, NGOs, farmers’ associations, local community leaders and policymakers. | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | | | | |
| Outcome/  Output/Activity | Sub-activity | | | **Budget line item** | | | | **WorldVeg** | **ICRISAT** | | **IITA** | | | | **AMEDD** | |  |
| Outcome 1/Output 1/  Activity 1 | MA1114-19 | | | Personnel | | | | 14,000 | 5,000 | | 3,000 | | | | 2,000 | |  |
| Services | | | | 11,000 | 5,000 | | 3,000 | | | | 2,000 | |  |
| Supplies | | | | 9,570 | 3,000 | | 2,000 | | | | 1,000 | |  |
| Capital | | | | - |  | |  | | | |  | |  |
| Travel | | | | 10,000 | 3,000 | | 2,000 | | | | 1,000 | |  |
| Overhead (22.1% for WorldVeg; 17% for ICRISAT) | | | | 10,430 | 2,720 | |  | | | | 1,020 | |  |
|  |  | | | **Total** | | | | **55, 000** | **18,720** | | **10,000** | | | | **7,020** | |  |
| **Grand total** |  | | |  | | | |  |  | |  | | | |  | | **90,740** |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | | **Apr** | | | | | **May** | | | | | **Jun** | | | | | **Jul** | | | | | **Aug** | | | | | **Sep** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | | **2** | **3** | **4** | **1** | | **2** | **3** | **4** | **1** | | **2** | **3** | **4** | **1** | | **2** | **3** | **4** | **1** | | **2** | **3** | **4** | **1** | | **2** | **3** | **4** |
| Planting nurseries |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Field preparation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Planting/Transplanting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Training |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Storage facilities construction & trial start |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Field maintenance |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Finalizing book chapters |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Data analysis and report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Field day |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Participatory technologies selection (varieties, storage management options) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Data upload in dataverse |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Conduct gender & economic surveys |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |
| Report submission (Interim/Final) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | | | |
| a. Output 1.1 | | | | Research products for more productive, intensive, diverse, profitable and resilient crop (cereals, legumes, and vegetables); livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | | | |
| b. Activity 1.1.2 | | | | Test and disseminate a combination of improved breeds, housing, feeding, health and breeding practices to intensify rearing of livestock (sheep, goat, pig, and poultry) for meat, egg and milk production. | | | | | | | | | | | |
| c. Sub-activity MA1121-19 | | | | Evaluate efficient feed utilization through improved feed troughs. | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | |
| Name | | Institution | | | | Role | | | | | | | | | |
| Augustine Ayantunde | | ILRI | | | | Coordination of sub-activity, data analysis and final report | | | | | | | | | |
| Theophile Dembele | | AMEDD | | | | Coordinate training of farmers, data collection and report of the training | | | | | | | | | |
| Koita Seydou | | AMEDD | | | | Data collection and entry | | | | | | | | | |
| Oumar Samake | | AMEDD | | | | Supervise AMEDD activities | | | | | | | | | |
| Bougouna Sogoba | | AMEDD | | | | Coordinate design of a prototype | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | |
| Name | Institute | | | | | | Degree | | Start | | | | End | | |
|  |  | | | | | |  | |  | | | |  | | |
|  | | | | | | | | | | | | | | | |
| f. Location(s) | M’Pessoba, Sirakele and Zanzoni in Koutiala district | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| g. Start | October 2018 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| h. End | March 2020 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | |
| Improved feed troughs for small ruminants and cattle were designed based on the specifications from Africa RISING Ethiopia and were demonstrated in M’Pessoba, Sirakele and Zanzoni in Koutiala district involving 45 farmers between January and April 2019. Preliminary results from data collected on the use of the improved feed troughs showed that the improved feed troughs reduced feed waste significantly by about 10%. The farmers confirmed that the main advantage of the improved feed troughs was that it led to a reduction in feed waste. The results in Ghana also showed that farmers spent about 10 minutes/day less time in feeding the animals with the improved feed troughs but the results in Mali did not show any difference in time spent in feeding the animals using the traditional and improved feed trough.  The data collection was only conducted in the late dry season and it is necessary to monitor the use of the improved feed troughs across different seasons (wet, early dry and late dry seasons) to have a correct assessment of the benefit of the technology. In addition, the cost of the improved feed troughs for cattle and small ruminants is currently high. Using the locally available construction materials may significantly reduce the cost of the improved feed troughs and will facilitate easier and quicker adoption by the farmers. This sub-activity, therefore, aims at building on the demonstration of the improved feed troughs by collecting additional data on the use across seasons and at the same time monitor the adoption by the farmers within and outside the intervention communities. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | |
| 2.1 The objectives of this sub-activity are: (i) To assess the effect of season on feed utilization including manure collection by the farmers using the improved feed troughs in three intervention communities in Koutiala district in Mali. (ii) To monitor the adoption of the improved feed troughs within and outside the intervention communities. (iii) To evaluate the potential and comparative economics around the use of local materials compared to available market materials for the construction of the improved feed troughs. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | | |
| 3.1 Do seasons affect the quantity of feed that could be saved through improved feed troughs? | | | | | | | | | | | | | | | |
| 3.2 Do improved feed troughs lead to increased manure collection compared to the traditional feed troughs? | | | | | | | | | | | | | | | |
| 3.3 Who are the adopters of the improved feed troughs and what are the drivers of adoption? What are the constraints to the adoption by non-adopters? | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.). | | | | | | | | | | | | | | | |
| The 45 farmers involved in the demonstration of the use of the improved feed troughs in M’Pessoba, Sirakele and Zanzoni in Koutiala district will be monitored over six days consecutively in each season, that is in the wet and early dry seasons to collect data on feed offered and the leftovers, and time spent feeding compared to the traditional feed troughs. In addition, the quantity of manure collected from the animals fed using the traditional and improved feed troughs will be measured during the days of the data collection.  To assess the potential of reducing the cost of the improved feed troughs, another five farmers will be selected randomly in each intervention community to build a feed trough with local materials. The design of the improved feed troughs with locally available materials will follow the same specifications provided by the Africa RISING Ethiopia prototype. Data will also be collected on the use of the feed troughs built with the local materials following the same procedures explained above for the improved feed troughs. Data to be collected will be feed offered (both in the morning and afternoon) and that wasted during the feeding process will be measured for six consecutive days, both for the traditional practice (spreading a portion of the feed on the ground) and wooden troughs.  The amount of time spent in looking after the animals while feeding (bringing back dispersed feed, keeping animals to feed comfortably) will be recorded for both practices. A survey questionnaire will be administered to participating farmers to document their opinions about the improved feed troughs built with local materials and their acceptance. A simple cost-benefit analysis of the improved feed trough will be conducted. Samples of the feed offered, and the leftovers will be analyzed for both improved feed troughs and traditional feeding practice. A survey on the adoption of the technology within and outside the intervention communities will be conducted to characterize the adopters and non-adopters, and the drivers of adoption. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | |  | | | | | |
| 5.1 Quantity of feed offered and leftovers, chemical composition of feed offered and leftovers, cost and benefit of the improved feed troughs, and time spent feeding the animals by different gender groups | | | | | | | | | | ILRI and AMEDD | | | | | |
|  | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | Delivery date | | | | |
| 6.1 Findings on testing and evaluation of the improved feed troughs compared to traditional practice | | | | | | Report to be published on CG Space | | | | | Mar. 2020 | | | | |
| 6.2 Data on use of improved feed trough | | | | | | Upload on Dataverse | | | | | Mar. 2020 | | | | |
| 6.3 Finalization of the West Africa Handbook in collaboration with the co-authors as a team | | | | | | Handbook chapter to be submitted to the chief scientist and made available on Google doc | | | | | Nov. 2019 | | | | |
|  | | | | | |  | | | | |  | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | | | | |
| Domain | | | Indicator | | | | | Metric and scale | | | | | | | |
| 7.1 Productivity | | | Input use efficiency, Manure collected | | | | | Feed savings (kg dry matter/household/season) at the household, manure quantity (kg DM)/household | | | | | | | |
| 7.2 Environmental | | | Manure quality | | | | | Nitrogen content of manure (g/kg DM) | | | | | | | |
| 7.3 Economic | | | Profitability  Labor requirement | | | | | Gross margin of the improved feed troughs at household level  Farmers’ rating of labor to feed the animals at household level | | | | | | | |
| 7.4 Social | | | Gender equity  Social Cohesion | | | | | Time spent on feeding the animals by gender in minutes/gender at household level  Participation in Community activities (as a result of saved time) | | | | | | | |
| 7.5 Human | | | Capacity to experiment | | | | | Number of modifications made to the feed troughs at household level  % farmers making modifications at community level | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | |
| The involvement of AMEDD in the testing and validation of the improved feed troughs will facilitate scaling of the technology as AMEDD is a developmental NGO involved in some development projects. Besides, the USAID Mali Livestock Technology Scaling Program will provide a platform for scaling of the improved feed troughs after testing and validation. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | |
| This activity is linked to sub-activity on dual-purpose sorghum varieties as the improved feed troughs will be used to feed the residues from the sorghum varieties at the Technology Park in M’Pessoba. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | |
| * Number of farmers that adopted the improved feed troughs | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed is improved food security for the smallholder crop and livestock farmers as improved feed troughs will enhance feed use efficiency thereby increasing livestock productivity and consequently food security of the farmers. Less feed waste can also contribute to a profitable livestock enterprise thereby improving household income. | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The target audience is smallholder crop and livestock farmers and extension agents. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | | |
| Outcome/Output/  Activity | | | | | Sub-activity | | | **Budget line item** | | | | **ILRI** | |  |  |
| Outcome 1/Output 1/ Activity 2 | | | | | MA1121-19 | | | Personnel | | | | 29,385 | |  |  |
| Services | | | | 22,892 | |  |  |
| Supplies | | | | 3,500 | |  |  |
| Capital | | | | 0 | |  |  |
| Travel | | | | 5,000 | |  |  |
| Sub-total | | | | 60,777 | |  |  |
| Overhead (ILRI 15%) | | | | 9,117 | |  |  |
| Overhead (ICRISAT 17%) | | | | 11,882 | |  |  |
|  | | | | |  | | | **Total** | | | | **81,776** | |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Design and evaluation including data collection of the use of improved feed troughs and those constructed with local materials |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Monitoring of modification and adoption of improved feed troughs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lab analysis of feed and faecal samples |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | |
| a. Output 1.1 | Research products for more productive, intensive, diverse, profitable and resilient crop (cereals, legumes, and vegetables); livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | |
| b. Activity 1.1.2 | Test and disseminate a combination of improved breeds, housing, feeding, health and breeding practices to intensify rearing of livestock (sheep, goat, pig, and poultry) for meat, egg and milk production. | | | | | | | | | |
| c. Sub-activity MA1122-19 | Demonstrate and promote fodder production for improved ruminant productivity. | | | | | | | | | |
|  |  | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | Institution | Role | | | | | | | | |
| Augustine Ayantunde | ILRI | Coordination of sub-activity, design of the study, data analysis and final report | | | | | | | | |
| Theophile Dembele | AMEDD | Coordinate establishment of the fodder demonstration plot at the Technology Park, training of farmers, data collection and report of the training | | | | | | | | |
| Bougouna Sogoba | AMEDD | Organization of participation at the Open Day | | | | | | | | |
| Oumar Samake | AMEDD | Supervise AMEDD activities | | | | | | | | |
|  | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | |
| Name | Institute | | Degree | | Start | | | End | | |
|  |  | |  | |  | | |  | | |
|  |  | |  | |  | | |  | | |
|  | | | | | | | | | | |
| f. Location(s) | Technology Parks in Koutiala and Bougouni districts | | | | | | | | | |
|  | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | |
|  | | | | | | | | | | |
| h. End | March 2020 | | | | | | | | | |
|  | | | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| Feed scarcity is one of the major constraints to ruminant production in Mali. There is great potential to bridge feed gap in smallholder mixed crop and livestock systems through the introduction of forage species in southern Mali given the annual rainfall of about 900 mm spread over 5 to 6 months. Under the USAID Mali Livestock Technology Scaling Program, there has been a demonstration of the potential of a few forage species as livestock feed, for example, *Brachiaria ruziziensis,* and the results look promising from the biomass produced. However, adoption has been limited. To promote adoption of the forage species, the establishment of demonstration plots at the Technology Park will expose many farmers to this technology and will provide an opportunity for learning on how to plant the fodder species. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | |
| The objectives of this sub-activity are:   1. To demonstrate the potential of forage species in bridging feed gap in smallholder mixed crop and livestock systems in southern Mali 2. To promote the adoption of forage species for improved ruminant productivity 3. To build capacity of farmers in forage production | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 What is the agronomic performance, particularly fodder biomass of the introduced forage species? | | | | | | | | | | |
| 3.2 How can the Technology Park facilitate the adoption of the forage species? | | | | | | | | | | |
| 3.3. How much fodder and over what area of production is regarded as sufficient for small ruminants during the dry season? | | | | | | | | | | |
| 3.4. How many additional days of feed, how much saved labor, and reduced risks does the fodder production offer to smallholder farmers? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.). | | | | | | | | | | |
| Fodder species namely *Brachiaria ruziziensis, Lablab purpureus* and *Sorghum almum* will be planted in the Technology Park in one community per region to demonstrate the potential of fodder production for improved ruminant production and to build the capacity of the farmers. A plot each measuring 50m2 (10 x 5m) will be established at the Technology Park in Koutiala and Bougouni for each fodder species. Agronomic data such as germination rate, plant height, leaf area index, and total biomass will be collected. Farmers will also be trained on how to plant the fodder species. The demonstration plots will be shown to farmers during the annual Africa RISING project farmers field day to promote adoption of the forage species by farmers. Farmers’ feedback on the performance of different forage species and the willingness of the farmer to grow Brachiaria in their farm in the next season will be collected. Training will be conducted for farmers on fodder production. | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | Responsibility/Institute | | | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | |  | | | | |
| 5.1. Germination rate, fodder biomass, plant height, leaf area index | | | | | | ILRI and AMEDD | | | | |
|  | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | |
| Deliverables | | | Means of verification | | | | Delivery date | | | |
| 6.1 Report of fodder production at the Technology Park | | | Report to be published on CG Space | | | | Mar. 2020 | | | |
| 6.2 Field day participation | | | Report of field day by ICRISAT published in Happenings | | | | Oct./Nov. 2019 | | | |
|  | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | |
| Domain | Indicator | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | Biomass Productivity  Forage quality | | Forage production (kg DM/ha/season) at plot level  Nitrogen and fiber content of fodder, and digestibility (g/kg DM) | | | | | | | |
| 7.2 Environmental | Water availability | | % of plants wilting | | | | | | | |
| 7.3 Economic | Profitability  Labor requirement | | Gross margin (cost and benefit of fodder produced)  Time required to establish the improved fodder plot (hour per ha) | | | | | | | |
| 7.4 Social | Gender equity  Social Cohesion | | Rating of technology by gender  Participation in Community activities (as a result of saved time or more time needed to fetch forages) | | | | | | | |
| 7.5 Human | Capacity to experiment | | % Farmers adopting improved fodder  Modification made by the farmers | | | | | | | |
|  | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | |
| The Technology Park will be used as a platform for scaling of the forage species. The annual field day will also provide an opportunity for farmers to learn about forage production will also be used to promote the dissemination of the technology. | | | | | | | | | | |
|  | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | |
| This sub-activity is linked to sub-activity MA4411-19 on Technology Park as the fodder demonstration plots will be established at the Park in both Koutiala and Bougouni district | | | | | | | | | | |
|  | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | |
| * Number of visitors to the Technology Park * Report on the fodder production | | | | | | | | | | |
|  | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed is improved food security for the smallholder crop and livestock farmers. Improving fodder production will enhance livestock productivity thereby food security of the farmers. | | | | | | | | | | |
| 11.2. Who is your target audience, e.g. extension agents, farmers, or policymakers?  The target audience includes farmers, extension agents and NGOs working on livestock issues. | | | | | | | | | | |
|  | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | |
| Outcome/Output/  Activity | | Sub-activity | | **Budget line item** | | | **ILRI** | |  |  |
| Outcome 1/Output 1/  Activity 2 | | MA1122-19 | | Personnel | | | 15,000 | |  |  |
| Services | | | 15,000 | |  |  |
| Supplies | | | 1,500 | |  |  |
| Capital | | | 0 | |  |  |
| Travel | | | 3,000 | |  |  |
| Sub-total | | | 34,500 | |  |  |
| Overhead (ILRI 15%) | | | 5,175 | |  |  |
| Overhead (ICRISAT 17%) | | | 6,745 | |  |  |
|  | |  | | **Total** | | | **46,420** | |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Establishment of fodder demonstration plot at the Technology Park M'Pessoba |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training of farmers in fodder production |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Collection of agronomic data |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | |
| a. Output 1.1 | | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | |
| b. Activity 1.1.3 | | | | Test and disseminate integrated crop-livestock-soil systems to increase and sustain productivity and reduce risk. | | | | | | | | |
| c. Sub-activity MA1131-19 | | | | Risk management and informed decision making towards sustainable intensification of crop-livestock systems. | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | Institution | | | | | Role | | | | |
| Katrien Descheemaeker | | | Wageningen University | | | | | Activity leader, student supervisor | | | | |
| Jeroen Groot | | | Wageningen University | | | | | Activity co-leader | | | | |
| Ken Giller | | | Wageningen University | | | | | Student supervisor | | | | |
| Bouba Traoré | | | ICRISAT | | | | | Collaborator | | | | |
|  | | |  | | | | |  | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | Institute | | | | | Degree | | | | Start | | End |
| Arouna Dissa | Wageningen University | | | | | PhD | | | | Jan. 2017 | | Dec. 2020 |
| Eva Huet | Wageningen University | | | | | PhD | | | | Jan. 2017 | | Dec. 2020 |
| Sedou Maiga | IPR/IFRA Bamako, Mali | | | | | MSc | | | | Jun. 2019 | | May 2020 |
|  | | | | | | | | | | | | |
| f. Location(s) | Koutiala, Mali | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | June 2018 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | May 2020 | | | | | | | | | | | |
|  |  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| Different crop-livestock intensification options and technologies have been tested in the Africa RISING project and other related research for development projects in the region. Notable examples of such options include soil fertility management technologies (such as mineral fertilizer, organic manure, including leguminous crops), fodder production, treatment and storage options, manure and compost management, stall feeding of cattle, small ruminant fattening. Adoption of these options by farmers depends not only on their performance in terms of improving productivity but also on their effects on indicators in a range of sustainable intensification domains. Usually, these effects are evaluated for current farms in current conditions. However, because of many biophysical and socio-economic drivers, farming systems are rapidly changing. As sustainable development should also consider long-term effects, there is a need to assess the multi-criteria effects also on future systems. Scenario analysis provides a basis to conduct such analyses.  Farming in southern Mali is conducted in a risky environment, related for instance to market and weather shocks and uncertainties. Crop-livestock interventions are usually not attractive to farmers if they increase farming risk. In order to tailor the interventions to the risky smallholder context, we need a better understanding of farmers’ risk mitigation strategies, and how the intended interventions contribute to or impede these strategies. As risk affects different farm components and farm activities and as different household members perceive and manage risk differently, a whole-farm and gender-disaggregated analysis is needed.  Another major bottleneck for the adoption of SI options is farmers’ limited planning and budgeting capacity for whole-farm management. Farmers need to balance (sometimes competing) objectives of food production and income generation under resource constraints related to capital, labor and land. Simple tools for record-keeping, for making objectives explicit and for budgeting farm activities, could assist farmers in taking the right strategic and tactical decisions for managing their farm. Incorporating the effects of promising crop-livestock intensification options in the tools mentioned above could help farmers to ex-ante assess the added value of their implementation. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 To explore the future impacts of sustainable intensification pathways in different SI domains (productivity, economic, environmental, human well-being) through scenario analysis and discuss these with local stakeholders. | | | | | | | | | | | | |
| 2.2 To assess the potential of crop-livestock and SI interventions in terms of risk mitigation in relation to for example weather and market shocks and uncertainty. | | | | | | | | | | | | |
| 2.3 To develop, test and adapt a decision support tool for farm planning and budgeting with farmers in southern Mali. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 What are the expected mid-term future impacts of agricultural interventions and policy interventions on the productivity, economic, environmental, food security domains of SI? | | | | | | | | | | | | |
| 3.2 What is the potential of crop-livestock, SI and collective marketing interventions for cushioning different types of farmers against common risks related to weather, labor and market shocks and uncertainties? | | | | | | | | | | | | |
| 3.3 How can farmers in southern Mali be supported in terms of farm planning and budgeting, and how does that influence their decisions to implement SI options? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| 4.1. In Falconnier *et al*. (2018) we conducted a scenario analysis to explore the effects of future development pathways on food self-sufficiency and farm income. The current situation was compared against 5 contrasting future scenarios combining policy and agricultural interventions for all 99 households of a village in southern Mali. The current situation was described based on household survey data from 2013. From that baseline, we looked 15 years ahead to describe plausible contrasting mid-term futures. In this activity, we are extending this scenario analysis with additional indicators in the productivity, environmental, economic and human well-being domain of SI. This work uses existing household datasets, crop model output, and the model described in Falconnier *et al*. (2018)[[70]](#footnote-70). Subsequently, the scenarios and the expected impact in different SI domains will be discussed with local stakeholders, including farmers, and higher-level decision-makers. | | | | | | | | | | | | |
| 4.2 Focus group discussions (FGDs) (n=8) and surveys (n=250) in 2017 and 2018 generated data and insight on risk perception and mitigation strategies. The analysis of the risk perception data per farm type will be complemented with a disaggregated analysis per group of gender, age and responsibility within the farm. Risk mitigation strategies will be disaggregated per farm type. The household survey will be used to explore which strategies are directed at which farm components and activities and to test whether specific farm types employ different strategies or target different farm components and activities.  Model analysis to explore the effects of risk mitigation strategies and the effects of specific crop-livestock interventions on risk and farm production stability (for different farm types). Here we will focus on the risks that are perceived by farmers as most important, being mostly weather and labour-related. The DSSAT crop growth model will be used and outputs will be integrated into a whole-farm analysis, based on existing detailed farm characterizations. Calibration of the model is done using previously defined (by project partners) parameters for crop varieties, soil and weather conditions relevant for the Koutiala region (e.g. Adam *et al*., 2018)[[71]](#footnote-71).  To understand the effects of various collective marketing models on cushioning farmers against market-related uncertainties and price fluctuations, individual interviews with farmers and other value chain actors will be conducted. An economic analysis will reveal the added value (or not) of increased bargaining power and stable and advantageous prices.  Farmers already participated in FGDs and surveys in 2017 and 2018 discussing their perception of risks and the strategies they apply. In the modeling exercise, the effects of these risks will be quantified. In 2020, during a new round of FGDs (n=4) in the four target villages the results will be discussed with farmers who participated in the risk surveys in 2018. Their risk perception and strategies will be either challenged or confirmed. The FGD will feed information back to farmers but will also contribute to the scientific discussion by learning from farmers’ feedback. | | | | | | | | | | | | |
| 4.3 Existing decision support tools and approaches that have been used in southern Mali and/or similar circumstances are inventoried to extract useful elements for the development of our own tool.  Development of detailed, research-oriented tools for record-keeping, farm planning and budgeting. These tools will be used with 22 farmers in villages around Koutiala in 2019, adapted based on farmers’ feedback and gathered insights, and used again in 2020. The detailed information collected through the implementation of the tools will be used for the development of a linear programming model for the exploration of different farming objectives and tradeoffs associated with resource allocation decisions.  The insights from the research-oriented tools will also aid the development of the farmer-oriented (“simple”) tool. This tool will be developed, tested and adapted for use by farmers and extension agents to aid decision making before, during and after the agricultural season. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | Responsibility | | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | |  | | | |
| 5.1 Results from the scenario analysis | | | | | | | | | WUR | | | |
| 5.2 Household risk survey data (complementing data on 2018 dataset) | | | | | | | | | WUR | | | |
| 5.3 Results from the risk modelling analysis | | | | | | | | | WUR | | | |
| 5.4 Farm records and data on farm planning | | | | | | | | | WUR | | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | Means of verification | | | | | | Delivery date | |
| 6.1 Conference presentation on scenario analysis | | | | | Book of Abstracts of Farming Systems Design conference | | | | | | Aug. 2019 | |
| 6.2 Conference presentation on risk analysis | | | | | Book of Abstracts of Farming Systems Design conference | | | | | | Aug. 2019 | |
| 6.3 Draft paper on risk mitigation strategies | | | | | Draft paper shared with ICRISAT and the chief scientist | | | | | | May 2020 | |
| 6.4 Farm planning and budgeting tool shared | | | | | The tool will be made available and shared with the chief scientist and Mali team through the activity leader | | | | | | May 2020 | |
| 6.5 Report on tool development and use | | | | | Report | | | | | | May 2020 | |
| 6.6 Finalization of the West Africa Handbook in collaboration with the co-authors as a team. Title: Approaches for taking technologies to scale through farmer research networks. | | | | | Handbook chapter submitted | | | | | | Nov. 2019 | |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | |
| Domain | | Indicator | | | | | Metrics/Scale | | | | | |
| 7.1 Productivity | | Crop Productivity  Animal productivity | | | | | Crop yield (kg/ha) at farm level  Farm level milk production (kg milk/farm/year) and animal production (animals/farm/year) | | | | | |
| 7.2 Environmental | | Nutrient partial balance | | | | | Nitrogen balance (kg N/ha); Nitrogen use efficiency (kg DM/kg N) | | | | | |
| 7.3 Economic | | Risk  Income variability  Profit variability | | | | | Frequency and impact of hazard occurrences, variability in farm profitability, enterprise budgets for livestock and crops ($/farm), agricultural profit ($/ha, $/farm), living income ($/capita/year), probability that profits are less than thresholds related to poverty and living income (%), labor productivity ($/man-day) | | | | | |
| 7.5 Human | | Nutrition | | | | | Food self-sufficiency (in calories, protein, micronutrients; % of requirements) | | | | | |
|  | | | | | | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 8. How will scaling be achieved? | | | | | |
| Quantified effects of crop-livestock intensification options on economic indicators and risk will allow a better understanding of important constraints and bottlenecks to adoption by farmers. By involving higher-level decision-makers in the feedback workshop on the scenario analysis, their awareness will improve, and they may be more prepared to take into account farmer constraints when prioritizing interventions for more widespread uptake. A disaggregated analysis, enabled by information gathered from different types of farmers and gender groups through the household surveys, will inform more effective tailoring of options.  The planning and budget tool will inform farmers about the potential effects and needed resources of SI options and practices, thus influencing famers’ decisions on the use of these options and practices. | | | | | |
|  | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | |
| Firstly, the activity can be linked to the sub-activity MA1113-19 which is using DSSAT model parametrization and outputs can be exchanged with researchers working in MA1113-19.  Secondly, the activity is in line with the USAID work on quantifying risk and resilience. | | | | | |
|  | | | | | |
| 10. Custom indicators | | | | | |
| * 4 focus group discussions on risk topics * Tool for focus group discussions and scenario feedback workshop shared. * 22 farmers trained on using the planning and budgeting tools | | | | | |
|  | | | | | |
| 11. Impact-based summary matrix | | | | | |
| 11.1 What is the development challenge you are addressing?  This activity attempts to close the gap between agricultural crop and livestock research and decisions making processes by farmers. It takes into account potential challenges and associated risks for farmers in the future through scenario analysis. | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?   * Farmers (budgeting tool and risk assessment) * Extension workers (budgeting tool) * Policymakers (risk quantification and scenario analysis on future developments) | | | | | |
|  | | | | | |
| 12. Budget (US$) | | | | | |
| Outcome/Output/Activity | Sub-activity | **Budget line item** | **WUR** |  |  |
| Outcome 1/Output 1/Activity 2 | MA1131-19 | Personnel | 16,440 |  |  |
| Services |  |  |  |
| Supplies |  |  |  |
| Capital |  |  |  |
| Travel | 4,000 |  |  |
| Sub-total | 20,440 |  |  |
| Overhead (WUR 16%) | 3,270 |  |  |
| Overhead (ICRISAT 17%) | 4,031 |  |  |
|  |  | **Total** | **27,741** |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | | **2019** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | |
| **Apr** | | | | **May** | | | | **Jun** | | | | **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Objective 2.1 | Selection of indicators |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| extension of the scenario analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| model simulation and data analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| stakeholder workshop |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| conference presentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Objective 2.2 | Organising input data (data cleaning and management) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Calibration DSSAT |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Selection of hazards to include in study |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Selection of risk management strategies to include in study |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Definition of management rules |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Development model set-up |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Analysis and simulation of SI options and risk management strategies |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Feedback sessions with farmers |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Objective 2.3 | Farm diagnosis based on typology |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Budgeting and planning of activities of rainy season |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Monitoring of on-farm activities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Detailed data collection on the testing farmers |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data entry |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ex-post assessment of on-farm activities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Planning of on-farm activities of dry season |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Feedback sessions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cleaning of detailed data collected |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Analysis of the detailed data collected |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Writing of the report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | |
| a. Output 1.2 | | | | | Integrated management technologies and practices to improve and sustain productivity and ecosystems services of the soil, land, water and vegetation resources are developed and disseminated to farmers and development partners in the intervention communities. | | | | | | | |
| b. Activity 1.2.1 | | | | | Test and disseminate land, soil and integrated land-soil technologies and practices to improve and sustain productivity and eco-systems services at the farm and landscape/watershed levels. | | | | | | | |
| c. Sub-activity MA1211-19 | | | | | Assess cropping management factors using empirical relations, GIS and Remote Sensing tools in two agro-ecologies of Mali. | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | | |
| Birhanu Zemadim | | | ICRISAT | | | Leader, Land and Water Management | | | | | | |
| Abdramane Ba | | | USTTB | | | Environmental engineer | | | | | | |
| Ramadjita Tabo | | | ICRISAT | | | Agronomist | | | | | | |
| Souleymane Sanogo | | | USTTB | | | Meteorologist and Climate Scientist | | | | | | |
| Kalifa Traore | | | IER | | | Plant and soil scientist | | | | | | |
| Bougouna Sogoba | | | AMEDD | | | GIS and Remote Sensing | | | | | | |
| Mahamadou Dicko | | | AMEDD | | | Activity coordination in Koutiala and Bougouni | | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | | | Institute | | | Degree | | | Start | | End |
| Karamoko SANOGO (PhD) | | | | USTTB | | | PhD | | | Jan. 2017 | | Mar. 2021 |
|  | | | |  | | |  | | |  | |  |
|  | | | | | | | | | | | | |
| f. Location(s) | Koutiala and Bougouni | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | June 2021 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| The semi-arid region of Mali is characterized by intensive agricultural practices, land degradation and very strong climatic variability. Soil water erosion consists of a major problem for agricultural productivity and monitoring erosion or soil loss becomes trivial when it’s done at an individual and separate or non-connected farmland areas as the whole landscape is prone to heavy erosion during storm events. Excessive and uncontrolled erosion is the main cause to a loss of inherent soil fertility levels of N, P, K, and thus to a decline in potential crop yield at plot or farm levels (Mahdi *et al*., 2002)[[72]](#footnote-72). Up until recently in most parts of southern Mali sustainable land management practices focused on reducing runoff and soil loss from plot or farm level through implementation of soil and water conservation (SWC) practices such as contour bunding. Though important in its application at plot or farm level, efficiency of contour bunding is limited to address landscape vulnerability of degradation and loss of crop productivity. Excessive soil water erosion is caused by an accumulated runoff from farm fields, grazing areas or from bushland or a combination of many land uses and land covers. Landscape-level information on the processes of soil water erosion and water infiltration and the associated losses of plant-available nutrients are often missing in most studies. In this study determination of crop management factors that are functions of soil water loss at a landscape level are conducted. The study includes identification and mapping of erosion factors at landscape levels and aims to build model parameters by estimating rainfall erosivity factor, soil erodibility factor, and topographic factors responsible for runoff generation in the watershed villages of Bougouni and Koutiala through empirical relations, GIS and Remote sensing techniques.  The study will be useful in providing guided information on the importance of controlling soil erosion at a landscape level and predict spatial distribution of plant nutrients suitable to increase crop productivity. To preserve soil and water resources, decision-makers need information on natural resources to plan suitable strategies and measures. Mapping soil erosion risk identifies vulnerable areas for environmental protection. In addition, the economic value of soil erosion can be used by the decision-makers to prioritize areas of soil conservation and integrated watershed management practices[[73]](#footnote-73). | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 Determine landscape level mean annual soil loss using empirical relations, GIS and Remote sensing techniques | | | | | | | | | | | | |
| * Assess the impact of soil erosion on landscape soils productivity | | | | | | | | | | | | |
| * Evaluate variations of plant-available nutrients, such as carbon, nitrogen, phosphorous, and potassium in different agro-ecologies under different land use systems | | | | | | | | | | | | |
| * Identify areas affected by natural and anthropogenic changes | | | | | | | | | | | | |
| * Provide appropriate guidance and recommendation on environmental protection to help increase crop productivity and reduce soil degradation | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 1. What is the spatial distribution of soil loss rate in southern Mali? | | | | | | | | | | | | |
| 1. By what amount soil water erosion affects smallholder rural agriculture yield? | | | | | | | | | | | | |
| 1. How important are efficient landscape erosion controlling measures advantageous from the ecologic and social perspectives to increase productivity and reduce poverty? | | | | | | | | | | | | |
| 1. What are the most vulnerable areas in the two agro-ecological zones? | | | | | | | | | | | | |
| 1. How do the interventions increase resilience of communities? E.g. if intervention X is conducted, it results in Y drought-free days which equates to building resilience. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, sample size, etc.) | | | | | | | | | | | | |
| 4.1 This work involves the use of soil moisture data collected in phase 1 of Africa RISING project (soil moisture data is available from 2014 to 2017) to investigate the influence of erosion on soil water infiltration. Remotely sensed soil moisture data will be correlated with the ground data to provide information on landscape soil moisture information. Long term data on rainfall amount and intensity will be used to estimate rainfall erosivity factor. The topographic map and Digital Elevation Map from high-resolution satellite imagery will be used to determine the soils topographic factor and soil erodibility factor. Here the GIS version of modified universal soil loss equation will be used to estimate soils topographic factors. Mapping of cropping management factors will be made at a landscape scale in the two agro-ecologies. Product maps will be produced to identify vulnerable areas at landscape level and will be communicated to land planners and national research institutes. | | | | | | | | | | | | |
| 4.2 A survey will be conducted to complete the study based on which conclusions and recommendations will be made for best management practices. The survey will investigate farmers’ perception of the influence of soils water erosions on smallholder income and the contribution of erosion to poverty and outward migration. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | Responsibility/Institute | | | |
| Is the data collected part of a multi-year experiment? | | | | | | | | |  | | | |
| 5.1 Soil sample | | | | | | | | | ICRISAT | | | |
| 5.2 Satellite images (Landsat) | | | | | | | | | ICRISAT | | | |
| 5.3 DEM | | | | | | | | | ICRISAT | | | |
| 5.4 Soil moisture | | | | | | | | | ICRISAT | | | |
| 5.5 Climate data | | | | | | | | | National meteorological station | | | |
| 5.6 Topography sheet | | | | | | | | | Institut Géographie Malienne (IGM) | | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | | Delivery date | |
| Spatial distribution map of soil erosion impact on soil productivity | | | | | | | Report integrated into the interim report submitted to IITA | | | | Feb. 2020 | |
| Shapefiles of soil erodibility and erosivity factors | | | | | | | Shape files produced and uploaded on Dataverse | | | | May 2020 | |
| Classified vulnerability of landscape pattern from multidisciplinary approach based on remote sensing (RS) and geographical information system (GIS) | | | | | | | Journal Article | | | | Jun. 2021 | |
| Assessed household perception on land management strategies for reducing soils erosion and improving soil fertility (Mahdi *et al.*2002)[[74]](#footnote-74) | | | | | | | Journal Article | | | | Jun. 2021 | |
| Finalization of the West Africa Handbook in collaboration with the co-authors as a team. Title: Improved land and water management practices on crop productivity and erosion control-lessons from southern Mali | | | | | | | Handbook chapter submitted | | | | Nov. 2019 | |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | |
| Domain | | Indicator | | | | | | Metrics/scale | | | | |
| 7.1 Productivity | | Crop Productivity | | | | | | Crop yield and biomass (Kg/ha) at farm level | | | | |
| 7.2 Environmental | | Erosion  Soil moisture  Soil fertility | | | | | | Changes in components affecting soil loss:  C factor (crop type, tillage)  P factor (practice to reduce erosion) at farm level | | | | |
| 7.3 Economic | | Profitability | | | | | | Net income, labor at farm level | | | | |
| 7.4 Social | | Equity | | | | | | Household level decision-making about production, marketing; access to production factors (mechanization, land) | | | | |
| 7.5 Human | | Nutrition  Food security | | | | | | Market supply of diverse food at landscape level  Diversity of crops grown at farm and household level | | | | |
|  | | | | | | | | | | | | |

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| --- |
| 8. How will scaling be achieved? |
| Scaling is achieved through promoting the landscape maps on soil loss and providing a guidance on appropriate land management practices at landscape levels. Scaling is done by project partners and others in Mali who are interested in landscape management practices like CARE-Mali, WFP and UNDP. Local NGOs will be used to train the farming communities in local languages on appropriate practices to reduce land degradation. The information generated from the different agro-ecologies on the benefits of reducing soil-water losses at the landscape levels will be communicated widely. |
|  |
| 9. How are the activities in this protocol linked to those of others? |
| This activity is linked to most agronomic, soil fertility improvements and soil and water conservation practices proposed in the sub activities of the work plan. |
|  |
| 10. Custom indicators |
| * Percentage of land area prone to erosion * Percentage gains in productivity by applying SWC practices at landscape levels * Resilience metrics as a result of SWC interventions * Number and types of technologies implemented |
|  |
| 11. Impact-based summary matrix |
| 11.1 What is the development challenge you are addressing?  Most of the farmlands in rural Mali are prone to erosion due to excessive rainfall within short duration. The extent of runoff generated hasn’t been studied well at a landscape level even though well-documented information at the farm level exists widely. By determining cropping management factors areas suitable for agricultural production will be studied and communicated. Degraded and erosion hotspot areas will be mapped for proper attention by the decision-makers. |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farmers in rural communities are the target groups. In addition, policymakers, land managers are the target groups. |
|  |
| 12. Budget (US$) |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Outcome/Output/  Activity | Sub-activity | **Budget line item** | **ICRISAT** | **AMEDD** |  |
| Outcome 1/Output 2/Activity 1 | MA1211-19 | Personnel | 15,000 | 2,500 |  |
| Services | 3,500 | 1,000 |  |
| Supplies | 2,500 | 3,000 |  |
| Capital |  |  |  |
| Travel | 4,500 | 1,500 |  |
| Overhead (17%) | 4,335 | 1,360 |  |
| **Total** | **29,835** | **9,360** |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | |
| **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Analysis of long-term soil data and archiving land use information |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Refining elements to determine cropping parameters |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Finalization of the West Africa Handbook in collaboration with the co-authors as a team |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Determination of Shapefiles of soil erodibility and erosivity |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Classified assessment of landscape analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Assessing household perception on land management strategies |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | | | | |
| a. Output 1.1 | | | Research products for more productive, intensive, diverse, profitable and resilient crops (cereals, legumes, vegetables), livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities. | | | | | | | | | | | | |
| b. Activity 1.2.1 | | | Test and disseminate land, soil and integrated land-soil technologies and practices to improve and sustain productivity and eco-systems services at the farm and landscape/watershed levels. | | | | | | | | | | | | |
| c. Sub-activity MA1212-19 | | | Improving crop-livestock productivity and household income through the use of contour bunding and agroforestry options. | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | |
| Name | | Institution | | | | Role | | | | | | | | | |
| Kalifa Traore | | IER | | | | Activity leader, protocol design, statistical analysis, reporting, supervision of ongoing PhD student | | | | | | | | | |
| Cheick Oumar Dembele | | IER | | | | Research assistant, implementation, data collection, continuation of PhD works, writing of the thesis | | | | | | | | | |
| Oumar Samake | | IER | | | | Research assistant, implementation, data collection | | | | | | | | | |
| Fotigui Cissé | | IER | | | | Research assistant, social data collection and support of trials implementation | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | |
| Name | | | | | Institute | | | Degree | Start | | | | End | | |
| Cheick Oumar Dembele | | | | | USTTB Mali | | | PhD | 2017 | | | | 2020 | | |
|  | | | | | | | | | | | | | | | |
| f. Location(s) | Koutiala (Kani, M’Pessoba) | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| g. Start | March 2017 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| h. End | April 2021 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | |
| Key elements to ensure sustainability of agriculture-livestock systems are adequate production of quality forage for animal supplementation but also availability of water and soil nutrients. Among these quality forages, fast-growing nitrogen-fixing tree species and herbaceous plants occupy a prominent place. According to Breman and Kessler (1995)[[75]](#footnote-75), the power to concentrate and save nutrients, produce and maintain high biomass quantity exceeds far that of cereals and other grass species. All the fast-growing nitrogen-fixing trees (FGNFT) are not acceptable to livestock because of nitrogen content and availability.  A study on fodder yield and nutritive value of many trees’ species in West African humid areas (Larbi *et al*., 2005)[[76]](#footnote-76), showed that *Gliricidia sepium and Leucaena leucocephala,* were identified to have high potential for the development of integrated crop-livestock agroforestry technologies because of fodder yield, concentrations of CP, NDF, ADF and lignin. Larbi *et al*. (2005) reported that coppicing regrowth of these species could be harvested between 16 and 20 weeks to maximize the yield and quality of the fodder.  In Western Kenya, a biomass yield of 21 t ha-1 was observed with *Sesbania sesban* on many nutrient-depleted soils (Sjogren *et al*., 2010)[[77]](#footnote-77). It is against this background that we proposed to study possibilities of introducing fast-growing forage tree species in farmers’ fields under Contour Bunding (CB) techniques. Traore *et al*. (2017a)[[78]](#footnote-78) reported that water storage was always higher in CB plots compared to control plots with a surplus of 0.23 mm day−1 in 2012 and 0.43-mm day −1 in 2013 in the CB plots over the monitoring period in the Cinzana Sahelian area of Mali. Also, millet grain yield in 2012, 2013, and 2014 was statistically higher in CB plots compared to the control with yield difference ranging from 301 kg ha−1 in 2012 to 622 kg ha−1 in 2013. These values corresponded to an increase of 60 and 56%, respectively. Concerning sorghum grain yield, it increased consistently from 461 kg ha−1 in 2012 to 1378 kg ha−1 in 2014. Moreover, the qualitative assessment done by farmers on the effects of CB revealed that rainwater was kept between contour ridges reducing runoff and consequently increasing infiltration and crop yields (grain and straw) in contoured plots. Also, with the use of CB, soil moisture was found to be better conserved and allowed field operations for an additional 7 to 10 days (Traore *et al.*, 2017b)[[79]](#footnote-79). Intercropping could also benefit from this technology and the ongoing PhD works showed a net benefit through the increase of the land equivalent ratio (LER) and the value to cost ratio (VCR), mainly when associated with micro-dosing of nutrients. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Objectives | | | | | | | | | | | | | | | |
| * 1. Assess the role of CB towards increasing household resilience against drought | | | | | | | | | | | | | | | |
| * 1. Evaluate crops and fodder plants growth and yields under CB technology | | | | | | | | | | | | | | | |
| * 1. Evaluate the effect of micro-dosing and intercropping system on crops yield | | | | | | | | | | | | | | | |
| 2.4 Develop a business model on nurseries that engage the youth and women farmers | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Research questions | | | | | | | | | | | | | | | |
| * 1. What are the impacts of CB on improving household resilience? | | | | | | | | | | | | | | | |
| * 1. What is the impact of CB on fodder tree production? | | | | | | | | | | | | | | | |
| * 1. Does micro-dosing and intercropping improve crop yields and farmers’ income in comparison with the recommended technique when combined with CB technology? | | | | | | | | | | | | | | | |
| 3.4 How does the business model on nurseries look like and can it be scalable? | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 1. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | | |
| * 1. Two types of experiments are proposed:      1. A trial with a factorial combination of two tillage practices (Contour bunding (CB) technology and no contour bunding (NCB) or farmer’s practices) with four types of soil fertilization, (i) no amendment, (ii) organic manure OM (5t ha-1), (iii) micro-dose OM (2.5t ha-1) + Complex cotton CC (100 kg ha-1) + Urea (25 kg ha-1), (iv) recommended dose = OM (5t ha-1) + Complex cotton CC (200 kg ha-1) + Urea (50 kg ha-1). The trial will be done in split-plot design with four replications; tillage practices represent the main plots with the soil amendments as sub-plots. The dimensions of the sub-plots are 4m x 3m. The main plots are 1m apart using cotton (*Gossypium sp.*) variety N’TA 93-15 as test crop. The same trial will be conducted on six different farms.      2. The second trial with a factorial combination of two tillage practices (CB and NCB) and three cropping variables: (i) sorghum sole crop, (ii) intercropping sorghum-soybean, (iii) soybean sole crop. The trial is in split-plot design with four replications. Tillage practices represent the main plots with the crops as sub-plots. The dimensions of the sub-plots are 10m x 5m. The main plots are separated by 1m. A local sorghum (*Sorghum bicolor* L. Moench), variety - named “Begnebling” in Kani and “Bentoroko” in M’Pessoba - which has a growth duration of 90-100 days and soybean (*Glycine max* (L.) Merr.) variety G115 which has a growth duration of 110 days are used as test crops.   The trial will be conducted on nine different farms and in one technology park. Amendments used in intercropping are: (i) Sorghum: OM (2.5t ha-1) + Complex cereal CC (50 kg ha-1) + Urea (25 kg ha-1), Soybean: OM (2.5t ha-1) + DAP (50 kg ha-1) | | | | | | | | | | | | | | | |
| * 1. Farmer selection: Forty collaborative farmers will be chosen because this number is what is feasible with accurate data according to the experiment type. Before implementation, soil sampling will be performed using an auger at 0-20 cm and 20-40 cm depth and samples sent for physicochemical analysis in the Soil-Water-Plant Laboratory of IER. The field of each farmer will be divided into two parts. The first part is under contour bunding (CB) i.e. ridges follow contour lines and the second one with farmer’s practices labeled as non-contour bunding (NCB) implemented as a control. The contour lines will be planted with fast-growing tree species chosen by farmers, such as *Gliricidia sepium* and *Leucaena leucocephala*. Trees will be planted on the crest of the contour bund which will be 0.8 m wide and 100 m long. The work involves the implementation of nurseries for the production of seedlings of fast-growing tree species. | | | | | | | | | | | | | | | |
| * 1. Establishment of tree nurseries: Tree nurseries will be established with the help of village youth and volunteer women farmers. The type and modality of established nurseries will be assessed regarding economic and social assessments of SIAF. If successful, the modality of scaling out nurseries to other locations will be formulated. | | | | | | | | | | | | | | | |
| * 1. Data analysis: Data will be analyzed using STATBOX 7. Analysis of variance will be used to assess the performance of treatments and means comparison by LSD procedure. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | |  | | | | | |
| 5.1 Biophysical data: height, basal diameter, crown radius and diameter at 1.3 m height when possible will be performed on fast-growing tree species starting at their planting date | | | | | | | | | | IER | | | | | |
| 5.2 Cultural operations: plowing or ridging date, planting date, emergence date, thinning date, planting density, plant density at harvest, plant height, grain yield, straw yield, thousand-grain yield | | | | | | | | | | IER | | | | | |
| 5.3 Soil physical and chemical properties | | | | | | | | | | IER | | | | | |
| 5.4 Crop yield (straw and grain) | | | | | | | | | | IER | | | | | |
| 5.5 Economic and social data on farmers’ engagement in tree nurseries | | | | | | | | | | IER | | | | | |
|  | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | Delivery date | | | | |
| 6.1 Data on agronomic and tree growth | | | | | | Data uploaded on Dataverse | | | | | May 2020 | | | | |
| 6.2 PhD Thesis submitted by Mr Cheick Oumar Dembele at Bamako University | | | | | | PDF copy of PhD thesis uploaded on CG Space | | | | | Dec. 2019 | | | | |
| 6.3 Experimental layout and nurseries established, and business model developed | | | | | | Progress Report submitted to ICRISAT | | | | | May 2020 | | | | |
| 6.4 Finalization of the West Africa Handbook in collaboration with the co-authors as a team Title: Soil erosion control and moisture conservation using contour ridge tillage in Bougouni and Koutiala in southern Mali. | | | | | | Handbook chapter submitted | | | | | Nov. 2019 | | | | |
|  | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | | Crop productivity  Input use efficiency  Cropping intensity | | | | | | Yield (kg/ha) at farm level  # of cropping seasons per year at farm level | | | | | | | |
| 7.2 Environmental | | Soil chemical properties, Soil fertility | | | | | | NPK, pH, OM at plot level | | | | | | | |
| 7.3 Economic | | Profitability, variability of profitability | | | | | | Farm-level cost-benefit analysis to determine the best fertilizer scenarios | | | | | | | |
| 7.4 Social | | Social cohesion  Gender Equity | | | | | | Participation in community activities at household level  Management control by gender; market participation by gender | | | | | | | |
| 7.5 Human | |  | | | | | |  | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | |
| After training of selected youth farmers on nursery techniques, they will develop a business model to supply demanding farmers with fast-growing tree species. In September, when there is little fieldwork, a farmer exchange visit will be organized to show the growth and development of the different fast-growing tree species planted on the crest of the contour line. In addition, a training on the implementation of the contour bund technology will be done within the community that will involve trained and knowledgeable farmers who will in turn train other farmers. Alternatively, there may be an option where farmers pay directly about 10 USD to AMEDD for implementation of the contour bunds. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | |
| N/A | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | |
| * Technology brief handbook * Number of nurseries established * PhD thesis | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge addressed is on how to integrate crop, livestock, and agroforestry to efficiently contribute to food security while adapting the production systems to climate change. | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farmers, Extension agents, NGO. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | | |
| Outcome/Output/Activity | | | | Sub-activity | | | **Budget line item** | | | | | **IER** | |  |  |
| Outcome 1/Output 2/  Activity 1 | | | | MA1212-19 | | | Personnel | | | | | 16,849 | |  |  |
| Services | | | | | 5,411 | |  |  |
| Supplies | | | | | 3,425 | |  |  |
| Capital | | | | |  | |  |  |
| Travel | | | | | 5,462 | |  |  |
| Overhead (IER 10%) | | | | | 3,114 | |  |  |
| Overhead (ICRISAT 17%) | | | | | 5,824 | |  |  |
|  | | | |  | | | **Total** | | | | | **40,085** | |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | |
| **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Training |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Refining elements |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Finalizing content\* Includes support to other Book Chapters |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stock of existing data |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Identification of knowledge gaps |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Plan on resilience/risk capacities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| KASA Analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Analysis and strategic insights |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Link resilience to cropping calendar |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets. | | | | | | | | | | | | |
| a. Output 1.2 | | | | Integrated management technologies and practices to improve and sustain productivity and ecosystems services of the soil, land, water and vegetation resources are developed and disseminated to farmers and development partners in the intervention communities. | | | | | | | | |
| b. Activity 1.2.2 | | | | Test and promote water management technologies and practices to increase water productivity in the small-scale crop-livestock farming systems under rainfed and irrigated conditions. | | | | | | | | |
| c. Sub-activity MA1221-19 | | | | Evaluate improved irrigation technologies for efficient and sustainable agricultural water management in rural Mali. | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | | Institution | | Role | | | | | | | |
| Birhanu Zemadim | | | ICRISAT | | Leader, Land and Water Management | | | | | | | |
| Ramadjita Tabo | | | ICRISAT | | Revising protocols and report writing | | | | | | | |
| Felix Badolo | | | ICRISAT | | Economic analysis | | | | | | | |
| Mahamadou Dicko | | | AMEDD | | Community mobilization | | | | | | | |
| Bougouna Sogoba | | | AMEDD | | Training enumerators | | | | | | | |
| Karamoko Sonogo | | | ICRISAT | | Research assistant (PhD candidate) | | | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | | Institute | | | | Degree | | Start | | End | |
| Intern (MSc.) | | | IPR/IFRA Katibougu | | | | MSc | | Jul. 2019 | | Jun. 2020 | |
|  | | | | | | | | | | | | |
| f. Location(s) | Koutiala and Bougouni | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | June 2021 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| In rainfed agricultural systems, sustainable and efficient water management practices are key to improved agricultural productivity and natural resources management. The agricultural productivity in sub-Saharan Africa (SSA) heavily relies on the availability of rainfall. With the erratic and unreliable rainfall pattern associated with poor and fragile soils, the crop and livestock productivity remained very low over the years in most of SSA countries including Mali. Much of the SSA agricultural land has been degraded and is less fertile as a result of continuous years of cultivation and being prone to wind and water erosion. This results in an increased food shortage because the land has not been able to support the food demands of the ever-increasing population. Better agricultural and nutritional security are further hampered by the lack of reliable access to the available water resources in the subsurface.  The two main surface water sources in Mali are the basins of Senegal River and Niger River with a total capacity of 70 billion metric cube of water in an average year. The volume of static underground water reserve is estimated at 2700 billion metric cube with an annual rate of 66 billion metric cube. The surface water contributes about 10 to 15% of the total volume of water consumed by populations, the balance of the demand is covered by underground water (DNH, 2016)[[80]](#footnote-80). Extraction and use of groundwater as a resource has been low mainly because in rural community settings large irrigation systems (through dams) are very expensive to implement (DNH, 2016[[81]](#footnote-81)). Small scale irrigation systems can be implemented at relatively low costs to benefit smallholder communities.  This work plan aims at improving agricultural productivity, nutritional security and household incomes through the use of solar energy pumps and improved irrigation technologies for efficient and sustainable agricultural water management in rural Mali. Similar to other SSA countries neither hydrocarbon energized motor pumps nor electrical pumps are affordable by the smallholder farmers in rural Mali. Introduction of solar energy-based irrigation pumps are ideal for increasing agricultural productivity and diversifying farming practices to produce high valued agricultural products like meat and vegetables. Solar panels are becoming more affordable and the improved solar photovoltaic (PV) technologies, with low carbon footprint have been identified as high potential solutions for rural electrification as well as water extraction for domestic, livestock and irrigation purposes in SSA. As such, solar PV pumps and improved irrigation technologies have become an emerging climate-smart technology in SSA for smallholder farmers (Schmitter *et al.*, 2018[[82]](#footnote-82)). To be highly productive the solar irrigation technologies need to be accompanied by improved agronomic management practices and soil moisture conservation techniques. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 Evaluate existing initiatives and constraints in using efficient and sustainable water management practices using solar energy pumps and improved irrigation technologies | | | | | | | | | | | | |
| 2.2 Identify public-private partnership through multi-stakeholder approaches to avail and promote solar energy pumps and improved irrigation technologies to smallholder farmers | | | | | | | | | | | | |
| 2.3 Conduct a multi-criteria GIS framework to map potential agricultural water management investment areas based on climate, topography and aquifer characteristics | | | | | | | | | | | | |
| 2.4 Develop appropriate and affordable methodology in using solar irrigation technologies along with improved agronomic management and soil moisture conservation technologies | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| * What are the existing initiatives and constraints of solar energy pumps and improved irrigation practices in Africa RISING intervention communities? | | | | | | | | | | | | |
| * Who are the reliable public-private partners to lead the development and dissemination of solar energy pumps and improved irrigation practices in the intervention communities? | | | | | | | | | | | | |
| * What are the solutions for potential agricultural water management investment for smallholder rural communities? | | | | | | | | | | | | |
| * What synergies exist and possibly practices having a reliable and appropriate methodology of sustainable water resources management with improved agronomic and soil moisture conservation technologies. | | | | | | | | | | | | |
| * + How do we scale and promote the developed methodology on agronomic, water management and soil and water conservation practices? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| The work utilizes survey data information on existing initiatives and practices of utilizing solar energy-based pumps and improved irrigation practices in Koutiala and Bougouni. This activity is done in the current season of the AR program and its output will determine to design solutions for agricultural water management investment options for the smallholder farming communities in its second-year study. GIS and Remote Sensing technologies along with climate information (e.g., solar radiation, number of sunshine hours etc.) will be employed to characterize and define suitable zones to implement solar-based energy pumps. Efficient water management solutions will be accompanied with other technologies (improved crop cultivars, soil and water conservation practices and agronomic packages) to evaluate the gains in productivity, environment, and economic, social, and human well-being of the sustainability options. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment? Yes | | | | | | | | | |  | | |
| Data on existing solar energy-based water management practices (2019) | | | | | | | | | | ICRISAT/AMEDD | | |
| GIS data on radiation, land and soil characterization (2019) | | | | | | | | | | ICRISAT/AMEDD | | |
| Suitability maps on potential agricultural investment zones in different agro-ecologies (2019/2020) | | | | | | | | | | ICRISAT/AMEDD | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | | | Date |
| A comprehensive report on existing initiatives and constraints of using solar energy-based pumps and improved irrigation practices | | | | | | | | Report included in Africa RISING interim and full reports | | | | Mar. 2020 |
| Work modalities established with public-private partners through multi-stakeholder engagements to use solar energy-based pumps and irrigation technologies and promote at scale | | | | | | | | Report included in Africa RISING interim and full reports | | | | Mar. 2020 |
| Multi criterial decision making (MCDM) tool developed as a planning and management solutions to assess the potential of agricultural water management investments | | | | | | | | Journal Article | | | | Mar. 2021 |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | |
| Domain | | Indicator | | | | Metrics/Scale | | | | | | |
| 7.1 Productivity | | Crop Productivity | | | | Yield and fodder (kg/ ha / season) at plot level. Farmer perceptions and ratings of technology yield performance as the result of the technologies at household level | | | | | | |
| 7.2 Environmental | | Erosion  Soil moisture | | | | # days during growing season without adequate soil moisture (from rain or irrigation) for crop growth at farm level  Farm-level: Depth to shallow groundwater  Household: # months without adequate supply of clean drinking water (within 500m), Farmer perceptions of water availability.  Landscape level: % hh with year-round access to drinking water, % of livestock farmers with year-round access to water, % of irrigable land (given current investment) with sufficient irrigation water, % of streamflow not diverted for agriculture or drinking water. % of water sources (wells, streams) with clean water, % of population with year-round clean drinking water. | | | | | | |
| 7.3 Economic | | Profitability | | | | Net returns per unit labor input, land input, capital input, at plot level.  % of production sold (by crop, animal product), % of land allocated to cash crops at farm level. % of total income from agriculture, % of total consumption from own production at household level. | | | | | | |
| 7.4 Social | | Equity  Level of social cohesion | | | | Variability and distributions of productivity, income and assets at landscape level  Active farmer groups, active innovation platforms, % of community members participating in some form of social group, # of conflicts over resources. Presence of formal agreements for resource sharing at landscape level | | | | | | |
| 7.5 Human | | Nutrition | | | | Market supply of diverse food, Infrastructure (e.g. warehousing, access to markets/roads, irrigation; dependent on geography), Number of farmers experimenting the technology at landscape level | | | | | | |
|  | | | | | | | | | | | | |

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| 8. How will scaling be achieved? | | | | | |
| Scaling is achieved through field demonstration of technologies perceived important by farmers. During phase I of the project we already established three solar pumped drip irrigation systems in the three technology parks. Farmers will be invited to witness the use of a combination of agronomic, soil and water conservation and improved irrigation technologies. The three sites will be demonstration places for research and capacity building activities. Other NGOs working and Farmers organization will be beneficiaries of the technologies. Scaling out of the practices will be done through government extension systems, local and international NGOs and other donors who are willing to invest in the practices for the smallholder farmers. | | | | | |
|  | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | |
| This activity is linked to most agronomic, soil fertility improvements and soil and water conservation practices proposed in the sub-activities of the work plan. | | | | | |
|  | | | | | |
| 10. Custom indicators | | | | | |
| * Number of beneficiaries of solar-based water pumps * Amount and types of crops grown with solar-based water pumps * Type of business enterprises promoting solar-based water pumps | | | | | |
|  | | | | | |
| 11. Impact-based summary matrix | | | | | |
| 11.1 What is the development challenge you are addressing?  In rural Mali, agricultural production and productivity have been hampered by lack of reliable rainfall. In most cases, the number of dry spells exceeds two to three weeks and frequent occurrence of terminal droughts are hampering gains in productivity usually during grain filling periods. The presence of improved water management practices like that of solar-powered irrigation systems is ideal to avail the required water input for supplementary irrigation during the rainy season and production of high valued crops during the dry season. | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Farmers in rural communities are the target groups. Also, suppliers of low-cost solar pumps and enterprises working on infrastructure development are targeted. | | | | | |
|  | | | | | |
| 12. Budget (US$) | | | | | |
| Outcome/Output/Activity | Sub-activity | **Budget line item** | **ICRISAT** |  |  |
| Outcome 1/Output 2/Activity 2 | MA1221-19 | Personnel | 24,000 |  |  |
|  |  | Services | 6,500 |  |  |
|  |  | Supplies | 3,500 |  |  |
|  |  | Capital |  |  |  |
|  |  | Travel | 3,500 |  |  |
|  |  | Overhead (17%) | 6,375 |  |  |
|  |  | **Total** | **43,875** |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sep** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | | **Jul** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Study existing initiatives and constraints of using solar energy-based pumps and improved irrigation practices |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Conducting survey in the intervention villages |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Multi-stakeholder engagement with public private partners |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 2: More farmers and farm families in the intervention communities are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition. | | | | | | | | | | | | |
| a. Output 2.2 | | | Postharvest technologies and practices to provide options for the food, and feed sectors are tested and disseminated to farmers through researchers, extension staff, and development partners. | | | | | | | | | |
| b. Activity 2.2.2 | | | Build capacity of farm families to reduce postharvest losses. | | | | | | | | | |
| c. Sub-activity MA2221-19 | | | Reduce vegetable postharvest losses through dissemination of Zero Energy Cool Chamber (ZECC), processing of vegetables and capacity building in the dry seasonin Bougouni and Koutiala. | | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | Institution | | | | Role | | | | | | |
| Edoh Ognakossan Kukom | | WorldVeg | | | | Sub-activity leader: postharvest expert | | | | | | |
| Wubetu Legesse | | WorldVeg | | | | Plant pathologist | | | | | | |
| Jean Baptiste Tignegre | | WorldVeg | | | | Plant Breeder | | | | | | |
| Mahamadou Dicko | | AMEDD | | | | Social scientist, community mobilizer | | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | Institute | | | | | | Degree | | Start | | End |
|  | |  | | | | | |  | |  | |  |
|  | | | | | | | | | | | | |
| f. Location(s) | Bougouni and Koutiala districts | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | June 2020 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| Vegetables are best stored in a cool and humid environment to prevent rot and dehydration due to their high perishability nature. However, in rural areas, farmers mainly store their harvested vegetable at ambient conditions leading to heavy post-harvest losses as well as a loss of income due to lack or unaffordability of electricity to have cooling facilities. Moreover, the limited occurrence of market days in such conditions forces farmers to sell off their products. A simple technology such as ZECC which creates cooling conditions without electricity can, however, best be recommended for the above-mentioned context to reduce postharvest losses of vegetables. ZECC technology is a small double-walled room which can be made with locally affordable materials and whose cavity is filled with sand and maintained wet with water. The technology works on the simple principle of evaporation by lowering inside temperature of the chamber to 10-15°C and increase inside relative humidity of the chamber to 95% compared to ambient conditions. These conditions inside the ZECC extend shelf-life of vegetable for a long time (weeks). Besides good postharvest handling practices to extend shelf-life of vegetables, processing is another option to extend the shelf-life and at the same time add value and increase market opportunities of fresh vegetables. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 Compare the performance of different vegetable ZECC-based storage techniques to assess their suitability to extend vegetable produce shelf life | | | | | | | | | | | | |
| 2.2 Demonstrate farmer-affordable vegetable product processing techniques | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 Is ZECC an effective technology in extending vegetable produce shelf life compared to ambient storage conditions? | | | | | | | | | | | | |
| 3.2 What differences exist between ZECC-based storing techniques to extend the vegetable shelf over time? | | | | | | | | | | | | |
| 3.3 What are farmers affordable processing methods that enable storage of vegetable produce over long periods? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | |
| Field experiments coupled with training sessions on good agricultural practices, postharvest handling and processing of vegetable will be carried-out at Africa RISING technologies park (Bougouni and Koutiala). The genetic material (tomato, African eggplant and vegetable cowpea) used in sub-activity MA1114-1902 will serve as products for postharvest tests and demonstrations. The field experiment layout on ZECC studies for each vegetable will be an RBD with 4 replications with four treatments: Vegetable stored in ZECC (T1), Vegetable mixed with shea butter wood ash (1:2 w/w) and stored in ZECC (T2), Vegetable mixed with shea butter wood ash (1:2 w/w) and stored in ambient conditions (T3) and Vegetable without any treatment and stored in ambient conditions (T4). Each district will be considered as a block and at level of each block, the experiment will be repeated two times over time (this totalizes to 4 replicates (2 blocks \* 2 times repeat of the experiment).  The experiment will also be conducted to compare a chimney solar dryer to sun drying (farmers’ traditional practice of drying) with tomato and pepper using RBD design with 4 replicates where a district will be considered as a block and each drying experiment repeated two times at level of each district. Processing training sessions (6 sessions) will focus on dried products, preparation of tomato paste, purée, vegetable brine and squash cream. For the ZECC experiment, data on temperature and relative humidity inside ZECC or in ambient conditions, shelf-life, weight loss, quality parameters (color, TSS, Acidity, Vitamin C) will be measured. For the drying experiment, data on drying rate, moisture content of the products as well as color will be recorded. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded in Dataverse | | | | | | | | | | Responsibility/Institute | | |
| Is the data collected part of a multi-year experiment? Yes | | | | | | | | | |  | | |
| 5.1 Monitoring data on produce storage trial in the ZECC | | | | | | | | | | WorldVeg | | |
| 5.2 Data on shelf-life, weight loss, quality parameters (color, TSS, Acidity) | | | | | | | | | | WorldVeg | | |
| 5.3 Abiotic data: temperature and relative humidity inside ZECC or in ambient conditions and the dryer | | | | | | | | | | WorldVeg | | |
| 5.4 Data on shelf-life, weight loss, quality parameters (color, TSS, Acidity, Vitamin C and moisture content) | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | Means of verification | | | | | | | Delivery date |
| 6.1 450 farmers trained on best postharvest and processing practices and awareness | | | | | Training manuals uploaded on CG space; List of participants included in the report submitted to IITA and copied to ICRISAT.  Data uploads on Dataverse. | | | | | | | Mar. 2020 |
| 6.2 Zero energy cooling chambers constructed | | | | | Technology physically available in two technology parks/hubs | | | | | | | Mar. 2020 |
| 6.3 Field days & participatory variety selection organized | | | | | Project report with a list of participants disaggregated by sex included in the interim and final reports submitted to IITA and ICRISAT | | | | | | | Mar. 2020 |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | |
| Domain | | Indicator | | | | | Metrics/Scale | | | | | |
| 7.1 Productivity | | N/A | | | | |  | | | | | |
| 7.2 Environment | | Plant biodiversity | | | | | Postharvest losses (% weight loss and shelf-life); environmental conditions (Relative humidity and Temperature in the ZECC) and drying rate | | | | | |
| 7.3 Economic | | Net income a ($/crop/ha/season) | | | | | Survey or participatory evaluations at the farm level | | | | | |
| 7.4 Social | | N/A | | | | |  | | | | | |
| 7.5 Human | | Food safety | | | | | Vegetable produce biochemical data (acidity, TSS, Vitamin C concentration and moisture); physical characteristic (color) | | | | | |
|  | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | |
| The training approach is the cascade training or training of trainers. This approach will enable to strengthen the capacity of lead beneficiaries, who will then train other beneficiaries once back in their village. This will enable scaling up of best practices to more people in target villages. The ZECC will also be scaled at the community level for the first time in Mali. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | |
| Vegetable products used for testing and demonstrations will be taken from the variety trial harvest in sub-activity MA1114-1901. The data collected from this trial will provide additional information on variety trials and vice versa. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | |
| * One article manuscript submitted in Oct. 2020 for publication in a peer-reviewed journal (Postharvest Biology and Technology) * Conference presentations | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  Postharvest losses of vegetables were ranked as the top three major constraints in Mali. There are no affordable and effective storage techniques available to farmers. A simple technology such as ZECC offers cooling conditions without electricity. At hottest periods in the year, ZECC can lower the inside temperature of the chamber to 10-15°C and increase inside relative humidity of the chamber to 95% as compared to ambient conditions. The use of ZECC technology in this sub-activity aims at extending shelf-life of vegetables for a long time (weeks). Processing vegetables also offers another opportunity granted to farmers to extend shelf-life, add value and increase market opportunities of fresh vegetables | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The beneficiaries are farmers in the intervention sites, food processing associations, vegetable retailers, extension agents and policymakers. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | |
| Outcome/Output/Activity | | | | Sub-activity | | | | | **Budget line item** | | **WorldVeg** | |
| Outcome 2/Output 2/  Activity 2 | | | | MA2221-19 | | | | | Personnel | | 6,000 | |
| Services | | 2,000 | |
| Supplies | | 1,000 | |
| Capital | |  | |
| Travel | | 2,000 | |
| Overhead (22.1%) | | 2,000 | |
|  | | | |  | | | | | **Total** | | **13,000** | |

13. Gantt chart

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| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sep** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | | **Jul** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Organization of farmers training |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Constructing zero energy cooling chambers |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Organization of farmers field day |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Participatory varietal selection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices. | | | | | | | | | | | |
| a. Output 4.1 | | | | Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices to scale. | | | | | | | |
| b. Activity 4.1.1 | | | | Conduct cost-benefit and gender analysis coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts. | | | | | | | |
| c. Sub-activity MA4111-19 | | | | Determine farmers’ preferences of technology attributes in cereal-legume systems of southern Mali. | | | | | | | |
|  | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | |
| Name | | Institution | | | Role | | | | | | |
| Felix Badolo | | ICRISAT | | | Economic research design, field coordination, data collection, analysis and report writing on farmers’ preferences | | | | | | |
| Bekele Kotu | | IITA | | | Overall coordination, collaborator economic research design, analysis and report writing on farmers’ preferences | | | | | | |
| Birhanu Zemadim | | ICRISAT | | | Identification and assessment of environment attributes of the technology | | | | | | |
| Baloua Nebie | | ICRISAT | | | Sorghum breeder, identification and assessment of productivity and other attributes of sorghum | | | | | | |
|  | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | |
| Name | Institute | | | | Degree | | | Start | | End | |
|  |  | | | |  | | |  | |  | |
|  | | | | | | | | | | | |
| f. Location(s) | Bougouni and Koutiala | | | | | | | | | | |
|  | | | | | | | | | | | |
| g. Start | September 2019 | | | | | | | | | | |
|  | | | | | | | | | | | |
| h. End | June 2020 | | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | |
| Adoption of agricultural technologies usually takes a long time or does not happen at the required level among smallholder farmers. This is partly because of the situation that technology development does not properly consider the traits of the technologies that farmers value most. Limited adoption can happen when technology development process fails to incorporate the traits valued by farmers (Lunduka R. *et al*, 2012[[83]](#footnote-83); Dalton, T.J., 2003[[84]](#footnote-84). While the traits of technologies associated with both consumption and production may be important to guide decisions among smallholder farmers, most studies focus on either of them at a time. However, considering either consumption-related traits or production-related traits of technologies separately may not give a full picture of farmers’ preferences. In fact, unlike farmers in developed countries, smallholder farmers in developing countries are both producers and consumers of their produce and hence they may evaluate technologies from both production and consumption angles before they decide to grow them.  Meanwhile, there are concerns nowadays that technology adoption is associated with unintended adverse effects on the farming system and the livelihoods of smallholder farmers. A good example is the famous green revolution. While the green revolution could reduce rural poverty through rapid growth in productivity (Hazell, P.B.R., 2009)[[85]](#footnote-85), it was associated with negative environmental consequences such as water pollution, health problems, and loss of biodiversity (Alauddin, M. and Quiggin, J. 2008[[86]](#footnote-86); Shiva, V., 1991[[87]](#footnote-87)). This implies that sustainability is an important evaluation criterion in the process of technology development. Sustainable intensification entails the application of agricultural technologies (or technology packages) having multidimensional advantages/positive traits (Pretty, J., Toulmin, C. and Williams, S., 2011)[[88]](#footnote-88). Therefore, assessing technologies concerning farmers’ preferences taking into account the multidimensional nature of sustainable agricultural intensification is useful to set research priorities and guide policy interventions. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | |
| 2.1 The study will identify important traits associated with sorghum technologies as perceived by farmers | | | | | | | | | | | |
| 2.2 Assessing the differences in the technology preferences among farmers concerning gender and other farmer typologies | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | |
| 3.1 What are the traits of sorghum varieties liked by smallholder farmers in southern Mali? | | | | | | | | | | | |
| 3.2 Are there differences among farmers’ categories (gender and typology) regarding preferences to technologies traits? | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | |
| We will collect data through a survey of about 600 randomly selected farm households in the three districts of southern Mali namely, Bougouni and Koutiala. Besides, we will conduct focus group discussions to collect qualitative data on farmers’ preferences and related issues. Discussions with researchers and other key informants will be made. The data from the focus group discussions and the key informant will be used to design the household survey and prepare the questionnaire. The survey will be organized following a choice experiment design in which respondents are asked to choose from the list of different hypothetical technology options presented to them. The choice sets will be fixed based on the discussions we will make with farmers, researchers, and other knowledgeable personalities or groups regarding the farming systems in southern Mali and the performances of various agricultural technologies. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | |  | | |
| 5.1 Survey data (qualitative and quantitative) on farmers’ preferences | | | | | | | | | ICRISAT | | |
| 5.2. Qualitative data; list of identified attributes based on focus group discussions | | | | | | | | | ICRISAT | | |
|  | | | | | | | | |  | | |
| 6. Milestones | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | Delivery date |
| 6.1 Focus group discussions of farmers and key informants (one discussion group per village with on average 5 to 10 participants) | | | | | | Qualitative data submitted to Dataverse repository | | | | | Dec. 2019 |
| 6.2. Household survey | | | | | | Survey data submitted to dataverse repository | | | | | May. 2020 |
| 6.3. Journal paper | | | | | | Manuscript submitted to African Journal of Economics | | | | | Jun. 2020 |
|  | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | |
| Domain | | | Indicator | | | | Metrics/Scale | | | | |
| 7.1 Productivity | | | N/A | | | |  | | | | |
| 7.2 Environmental | | | N/A | | | |  | | | | |
| 7.3 Economic | | | N/A | | | |  | | | | |
| 7.4 Social | | | Rating of technologies by gender | | | | Participatory evaluation at the field/farm level | | | | |
| 7.5 Human | | | Capacity to experiment | | | | number of new practices being tested at the household level through surveys | | | | |
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| 8. How will scaling be achieved? | | | | | |
| This study focuses on technology traits associated with consumption and production to guide farmers’ decisions for the application of the technology. The results of the study will help guide researchers to generate technologies that will have a high chance of adoption. It will also help the government extension department and other development practitioners to prioritize technologies for scaling and do proper targeting which will enhance adoption. | | | | | |
|  | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | |
| The study assesses technologies concerning farmers’ preferences to improve adoption. Therefore, this study is linked to activities on dual-purpose sorghum and contour bunding technologies. | | | | | |
|  | | | | | |
| 10. Custom indicators | | | | | |
| * One published paper in peer-reviewed journal * One oral presentation at an international conference by December 2020 | | | | | |
|  | | | | | |
| 11. Impact-based summary matrix | | | | | |
| 11.1 What is the development challenge you are addressing?  Many agricultural technologies have been developed and are available, but many constraints considerably limit their adoption. Technology scaling is easier when technologies are compatible with farmers’ needs and this would happen when farmers’ technology preferences are taken into account in the process of technology development. One of the limitations in the agricultural research process is the fact that farmers’ preferences are usually overlooked. Moreover, farmers are not homogenous in their references while technology development mostly fails to take into account such heterogeneities among farmers. Such situations in the research process have resulted in low demands among farmers for new technologies, early dis-adoption, and sub-optimal adoption while making the scaling process quite challenging. This study addresses this challenge of adoption of agricultural technologies among smallholder farmers. | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Our study targets a large audience including: i) researchers to set research priorities and define the scaling strategies taking into account the farmers’ preferences; ii) extension agents for the technologies scaling on the fields; iii) policymakers to guide the policy interventions, and iv) farmers to make available the technologies that meet their needs in terms of consumption and production. | | | | | |
|  | | | | | |
| 12. Budget (US$) | | | | | |
| Outcome/Output/Activity | Sub-activity | **Budget line item** | **ICRISAT** |  |  |
| Outcome 4/Output 1/  Activity 1 | MA4111-19 | Personnel | 20,000 |  |  |
| Services | 5,500 |  |  |
| Supplies | 3,500 |  |  |
| Capital |  |  |  |
| Travel | 6,500 |  |  |
| Overhead (17%) | 6,035 |  |  |
|  |  | **Total** | **41,535** |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | |
| **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Training for the focus group discussion |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Focus group discussion on the farmers' preferences |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and technical report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Household survey / data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and technical report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Development of manuscript and submission |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices. | | | | | | | | | | | | |
| a. Output 4.3 | | | A framework for monitoring and evaluating technology adoption, and technology-associated risk accessible to the project team and scaling partners. | | | | | | | | | |
| b. Activity 4.3.1 | | | Monitor and modify the progress of technology adoption process towards scaling. | | | | | | | | | |
| c. Sub-activity MA4311-19 | | | Evaluating the effect of community local conventions for natural resource management in southern Mali. | | | | | | | | | |
|  | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | |
| Name | | Institution | | | | Role | | | | | | |
| Augustine Ayantunde | | ILRI | | | | Coordination of sub-activity, design of the study, data analysis and final report | | | | | | |
| Issaka Coulibaly | | AMEDD | | | | Coordinate the surveys and data collection in the study sites | | | | | | |
| Koita Seydou | | AMEDD | | | | Data collection and entry | | | | | | |
| Oumar Samake | | AMEDD | | | | Supervise AMEDD activities | | | | | | |
|  | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | |
| Name | | | | Institute | | | | Degree | Start | | | End |
|  | | | |  | | | |  |  | | |  |
|  | | | |  | | | |  |  | | |  |
|  | | | | | | | | | | | | |
| f. Location(s) | Dieba in Bougouni district, Sirakele and Zanzoni in Koutiala district | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| g. Start | October 2019 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| h. End | March 2020 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | |
| Local conventions governing natural resource management in many rural communities including Africa RISING intervention communities are largely oral. AMEDD and ILRI, therefore, facilitated the documentation, validation, development and formalization of the local conventions in 3 communities namely Dieba, Sirakele and Zanzoni in southern Mali in 2016. Also, livestock corridors in each village territory were demarcated and a surveillance committee was established in each community for the implementation of the local conventions. There was positive feedback from the communities in 2016 shortly after the commencement of the implementation of the local conventions. The external review team for Africa RISING included the success story of the local conventions in their report particularly in reducing conflict over natural resource use. It is now about 3 years since the implementation of the local conventions began and it is necessary to evaluate the present effect on natural resource management and the conflict over natural resources use. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | |
| 2.1 The objectives of this sub-activity are:   1. To assess the current state of the implementation of the formalized local conventions on natural resource management in three intervention communities, that is, what is working well and what is not working. 2. To evaluate the effect of the implementation of the local on natural resource management and conflict over natural resource use. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | |
| 3.1 What is the current state of the implementation of the local conventions in the three intervention communities? | | | | | | | | | | | | |
| 3.2 What are the challenges faced with the implementation of the local conventions? | | | | | | | | | | | | |
| 3.3 What are the lessons that can be learnt from the implementation of the local conventions in the three communities that can facilitate scaling of this technology? | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.). | | | | | | | | | | | | |
| Group discussion and individual interviews will be conducted to document the perceived effect of the implementation of the local conventions on natural resource management and conflict over natural resource use in the three intervention communities (Dieba, Sirakele and Zanzoni). Members of the surveillance committee in each community for the enforcement of the local conventions will be interviewed on the state of the implementation of the local resource institutions. At least 30 individuals stratified by gender will be interviewed in each community on the perceived effects of the local conventions. The local government officials will also be interviewed on the challenges and opportunities through the implementation of the local conventions. Cases of conflict before and after the implementation of the local conventions will also be documented. | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | Responsibility/Institute | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | | |  | | |
| 5.1 Perception on the effects of the implementation of local conventions on natural resource management | | | | | | | | | | ILRI and AMEDD | | |
|  | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | | Delivery date | |
| 6.1 Report of the perceived effect of the local conventions on natural resource management | | | | | | | Report to be published on CG Space | | | | Mar. 2020 | |
|  | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | |
| Domain | Indicator | | | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | N/A | | | |  | | | | | | | |
| 7.2 Environmental | N/A | | | |  | | | | | | | |
| 7.3 Economic | N/A | | | |  | | | | | | | |
| 7.4 Social | Social cohesion | | | | Incident of conflict in the community  Modification made by the community to the local conventions | | | | | | | |
| 7.5 Human | N/A | | | |  | | | | | | | |
|  | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | |

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| The processes for the documentation, validation and formalization of the local conventions have been documented by AMEDD and a video has been produced on this which is available on YouTube: <https://www.youtube.com/watch?v=UskGMIkG6_0>. AMEDD has been scaling the technology to many communities in Mali through another project. This sub-activity will facilitate further scaling of the local conventions. | | | | | |
|  | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | |
| This sub-activity can be linked to previous work on the local conventions in 2016 and can inform Monitoring and Evaluation framework for scaling of Africa RISING technologies. | | | | | |
|  | | | | | |
| 10. Custom indicators | | | | | |
| * Number of participants at the group discussion in each intervention community * Report on the sub-activity | | | | | |
|  | | | | | |
| 11. Impact-based summary matrix | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed by this sub-activity is environmental degradation that comes from weak local institutions governing natural resource management which can impact on livelihoods of the local communities and food security. The formalized local conventions can, therefore, improve natural resource management and environmental health thereby impacting positively on household food security and resilience of the farming systems. | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Community leaders, policymakers. | | | | | |
|  | | | | | |
| 12. Budget (US$) | | | | | |
| Outcome/Output/Activity | Sub-activity | **Budget line item** | **ILRI** |  |  |
| Outcome 4/Output 3/  Activity 1 | MA4311-19 | Personnel | 15,000 |  |  |
| Services | 6,000 |  |  |
| Supplies | 1,000 |  |  |
| Capital | 0 |  |  |
| Travel | 1,500 |  |  |
| Sub-total | 23,500 |  |  |
| Overhead (ILRI 15%) | 3,525 |  |  |
| Overhead (ICRISAT 17%) | 4,594 |  |  |
|  |  | **Total** | **31,619** |  |  |

13. Gantt Chart

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Preparation of survey instruments |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Organization of Focus Group Discussion in 3 communities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Conduct of individual interviews in 3 communities |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices. | | | | | | | | | | | | | | | | |
| a. Output 4.3 | | | | | A framework for monitoring and evaluating technology adoption, and technology-associated risk accessible to the project team and scaling partners. | | | | | | | | | | | |
| b. Activity 4.3.1 | | | | | Monitor and modify the progress of technology adoption process towards scaling. | | | | | | | | | | | |
| c. Sub-activity MA4312-19 | | | | | Assess the impact of Innovation Platforms on SI technology uptake in Africa RISING interventions communities. | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | | | | | | |
| Bougouna Sogoba | | | AMEDD | | | Activity coordination | | | | | | | | | | |
| Mahamadou Dicko | | | AMEDD | | | Data analysis | | | | | | | | | | |
| Arouna Bayoko | | | AMEDD | | | Multi-stakeholder facilitator | | | | | | | | | | |
| Toumani Sidibe | | | FENABE | | | Multi-stakeholder facilitator | | | | | | | | | | |
| Gundula Fischer | | | IITA | | | Contribution to research protocol development and report writing | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | | |
| Name | | Institute | | | | | | Degree | | | Start | | | End | | |
| Gilbert Dembele | | AMEDD | | | | | | MSc | | | Oct. 2019 | | | Jun. 2020 | | |
|  | | | | | | | | | | | | | | | | |
| f. Location(s) | | Koutiala and Bougouni | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| g. Start | | September 2019 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| h. End | | June 2020 | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | | |
| During phase I of Africa RISING project in Mali four Innovation Platforms were established; two at the communal level and two at the district level. These IPs were used as platforms for learning, information exchange and technology dissemination. It is important to assess the impact of the developed Innovations Platforms in technology dissemination in the interventions communities and use these results to strengthen and sustain multi-stakeholder meetings in interventions communities to increase wider scaling of technologies validated by Africa RISING research activities. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | | |
| 2.1 To assess the impact of Innovation Platforms on farmers’ access to information and SI technology uptake | | | | | | | | | | | | | | | | |
| 2.2 To improve adoption of SI innovation in intervention communities through advanced co-learning and exposure to validated technologies /innovations | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | | | |
| 3.1 What are the roles of innovation platforms vis-à-vis increased farmers’ awareness and adoption of validated technologies? | | | | | | | | | | | | | | | | |
| 3.2 To which extent Innovation Platforms worked during the first phase of Africa RISING and improved farmers access to information on SI technologies and SI technology dissemination? | | | | | | | | | | | | | | | | |
| 3.3 How would the lessons learned from innovation platforms feed into multi-stakeholder interest group meetings and help women and youth farmers to access SI innovations? | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, stakeholder meetings etc.) | | | | | | | | | | | | | | | | |
| Focus group discussion and key informant interview will be conducted to assess the impact of innovation platforms on beneficiaries’ access to information and their scaling.  Multi-stakeholder meetings will be conducted in the four technology parks and at district level to utilize the knowledge gained from IPs and increase awareness of farmers on SI innovations. Farmer to farmer exchange visits and farmer field days will be arranged to increase the awareness of SI options. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | | Responsibility/ Institute | | | | |
| Is the collected data part of a multi-year experiment/trial? No | | | | | | | | | | | |  | | | | |
| 5.1 Survey data on impact of IPs towards SI technologies uptake | | | | | | | | | | | | AMEDD | | | | |
| 5.2 Data on IP membership and functionality | | | | | | | | | | | | AMEDD | | | | |
|  | | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | | | | | Delivery date | | |
| 6.1 Impact assessment report | | | | | | | Report submitted to ICRISAT and included in the interim and final reports | | | | | | | Jun. 2019 | | |
| 6.2 Report on multi-stakeholder meeting, attendance list of members of IP | | | | | | | Report included in the interim and final year reports submitted to ICRISAT | | | | | | | Dec. 2019 | | |
| 6.3 Publication on women and youth participation in multi-stakeholder platform | | | | | | | Draft publication shared with ICRISAT and the chief scientist | | | | | | | Jun. 2020 | | |
|  | | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | | | | | |
| Domain | Indicator | | | | | | | | Metrics/Scale | | | | | | | |
| 7.1 Productivity | N/A | | | | | | | |  | | | | | | | |
| 7.2 Environment | N/A | | | | | | | |  | | | | | | | |
| 7.3 Economics | N/A | | | | | | | |  | | | | | | | |
| 7.4 Social | Level of social cohesion  Level of collective action | | | | | | | | Decision-making about production, marketing (by crop); Women Empowerment in Agriculture Index;  Households participation in community activities; hh participation in a collective action group  Landscape/Administrative level: Active farmer groups, Active innovation platforms, % of community members participating in some form of social group, number of problems addressed by innovation platforms | | | | | | | |
| 7.5 Human | N/A | | | | | | | |  | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | | |
| The results of the impact assessment will improve multi-stakeholder platform meetings and increase uptakes of technologies and innovations in intervention communities while farmers field days will increase the exposure of producers to SI technologies and increase their adoption by the latter. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | | |
| This activity is linked to activities that are conducted in the technology parks and intervention villages. IPs are channels through which demand-driven action research is conducted and research results are communicated to village communities through IP channel. Hence this work plan is related to all implemented activities. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | | |
| * Number of multi-stakeholder platforms * Number of attendants of multi-stakeholder platform meetings | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed by this sub-activity is understanding the role of innovation platforms for technology scaling and how the knowledge gained from innovation platforms spill over to multi-stakeholder interest groups | | | | | | | | | | | | | | | | |
| 11.2. Who is your target audience, e.g. extension agents, farmers, or policymakers?  Extension agents, farmers, researchers and policymakers. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 12. Budget | | | | | | | | | | | | | | | | |
| Outcome/Output/Activity | | | | Sub-activity | | | | | | **Budget line item** | | | **AMEDD** | |  |  |
| Outcome 4/Output 3/Activity 1 | | | | MA4312-19 | | | | | | Personnel | | | 10,000 | |  |  |
| Services | | | 7,500 | |  |  |
| Supplies | | | 8,000 | |  |  |
| Capital | | | 0 | |  |  |
| Travel | | | 8,000 | |  |  |
| Overhead (ICRISAT 17%) | | | 5,695 | |  |  |
|  | | | |  | | | | | | **Total** | | | **39,195** | |  |  |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Year/ Month/Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Literature review |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Refining of research tools |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training of enumerators |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Statistical and content analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Quarterly report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Final Report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Draft of scientific publication |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 4: Effective partnerships to ensure delivery and large-scale uptake of SI technologies and practices are established with farmers, local communities, and research and development partners in the private and public sectors. | | | | | | | | | | | | | | | | |
| a. Output: 4.3 | | | | An updated framework for monitoring technology adoption to be used by the project team and scaling partners available and accessible. | | | | | | | | | | | | |
| b. Activity 4.3.1 | | | | Monitor and modify the progress of technology adoption process towards scaling. | | | | | | | | | | | | |
| c. Sub-activity MA4313-19 | | | | GIS mapping of implemented technologies across different agro-ecologies and gender influence in technology adaptation and use in Bougouni and Koutiala districts of Mali. | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | | | | | | | |
| Bougouna Sogoba | | | AMEDD | | | Activity Leader | | | | | | | | | | |
| Mahamadou Dicko | | | AMEDD | | | Social Scientist | | | | | | | | | | |
| Birhanu Zemadim | | | ICRISAT | | | Project Collaborator | | | | | | | | | | |
| Gundula Fischer | | | IITA | | | Social Scientist | | | | | | | | | | |
| Gilbert Dembele | | | AMEDD | | | Remote Sensing | | | | | | | | | | |
| Safia Abdelmounaime | | | AMEDD | | | Remote Sensing scientist | | | | | | | | | | |
| Oumar Samake | | | AMEDD | | | Economist | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | | |
| Name | Institute | | | | | | Degree | | | Start | | | | End | | |
| Gilbert Dembele | AMEDD | | | | | | M.Sc. | | | Oct. 2019 | | | | Jun. 2020 | | |
|  | | | | | | | | | | | | | | | | |
| f. Location(s) | Koutiala and Bougouni | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| g. Start | July 2018 | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| h. End | June 2020 | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | | |
| Technology adoption by farmers is linked to changes in the environment and climate. It depends also on household socio-economic status and the cultural acceptance of technologies. Therefore, the reliability and replicability of each technology depend on the specific context. Regarding the available technologies developed in phase 1 and those under validation in phase 2 (Bougouni and Koutiala districts in Mali), it is important to characterize technologies uptake regarding gender, ecological and socio-economic context. The cost and benefit analysis can help to explain the adoption rate by farmers’ categories. To analyze all these factors regarding the spatial variations, remote sensing and GIS is well indicated. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | | |
| 2.1 To map and characterize Africa RISING technologies for different agro-ecologies and socio-economic settings | | | | | | | | | | | | | | | | |
| 2.2 To assess gender influence in technology adaptation and use | | | | | | | | | | | | | | | | |
| 2.3 To assess the social and economic impact of multiple interventions vis a vis of single intervention in target communities | | | | | | | | | | | | | | | | |
| 2.4 To evaluate how the cereal and legume value chains have to function to ensure ecological and socio-economic resilience | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | | | |
| 3.1 To which extent Africa RISING technologies have been adopted under different socio-economic and environmental conditions in Mali? | | | | | | | | | | | | | | | | |
| 3.2 How does gender influence technology adaptation and use in intervention communities? | | | | | | | | | | | | | | | | |
| 3.3 What are the social and economic impacts of multiple interventions vis a vis of single intervention in target communities? | | | | | | | | | | | | | | | | |
| 3.4 What is the gap in the cereal and legumes value chains for resilience upgrading? | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | | | |
| The protocol will follow the remote sensing image (Landsat, Sentinel 2) change detection-based analysis. The aim is to map the trend of changes regarding land cover and land within the project intervention areas. The reference dates will be 2000 to 2018. Auxiliary data such as transportation networks (roads, trails), water sources, villages territories will be used to enhance the understanding of the context of each site. To link each farmer adaptation story to its geographical context, each farm will be geolocated. This allows the use of the change detection analysis results. In the different villages, socio-economic data on the households’ conditions and gender influence in technology uptake will be collected and analyzed using GIS tools to link environmental status to socioeconomic status and the location where the technologies have been adopted or adapted. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | Responsibility/Institute | | | | | |
| Is the collected data part of a multi-year experiment/trial? | | | | | | | | | | | Yes | | | | | |
| 5.1 Baseline data on farmers and coordinates of fields | | | | | | | | | | | AMEDD | | | | | |
| 5.2 Socio-economic data (Household survey) | | | | | | | | | | | AMEDD | | | | | |
|  | | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | | |
| Deliverables | | | | | | | | Means of verification | | | | | Delivery date | | | |
| 6.1 Freely available land use and land cover maps, changes detection map from Landsat at 30 m resolution | | | | | | | | Maps uploaded on Dataverse | | | | | Jun. 2020 | | | |
| 6.2 Scientific article on context domain of technologies in Koutiala and Bougouni districts | | | | | | | | Draft publication | | | | | Jun. 2020 | | | |
| 6.3 Scientific article on Gender Influence in Technology adaptation and use | | | | | | | | Draft publication | | | | | Dec. 2021 | | | |
|  | | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators and metrics | | | | | | | | | | | | | | | | |
| 7.1 Productivity | | N/A | | | | | | | | | | | | | | |
| 7.2 Environmental | | N/A | | | | | | | | | | | | | | |
| 7.3 Economic | | N/A | | | | | | | | | | | | | | |
| 7.4 Social | | N/A | | | | | | | | | | | | | | |
| 7.5 Human | | N/A | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | | |
| The determination of the analogue sites and the adoption or adaptation condition will help to better orient the scaling up of different technologies developed by Africa RISING | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | | |
| Remote sensing and GIS will be used to map uptake of sub-activities conducted: MA1112-19, MA1113-19, MA1114-19, MA1121-19, MA1122-19, MA1211-19, MA1212-19, MA1221-19 and MA4311-19. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 10. Custom indicators | | | | | | | | | | | | | | | | |
| * Number of hectares under each technology * Number of farmers adopting specific technologies * Number of technologies available for dissemination | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 11. Impact-based summary matrix | | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  The development challenge being addressed by this sub-activity is understanding the agro-ecological classes where adoption of Africa RISING technologies took place | | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  Extension agents, farmers, researchers and policymakers. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | | | |
| Outcome/Output/Activity | | | | | Sub-activity | | | | **Budget line item** | | | **AMEDD** | | |  |  |
| Outcome 4/Output 3/Activity 1 | | | | | MA4313-19 | | | | Personnel | | | 12,000 | | |  |  |
| Services | | | 4,000 | | |  |  |
| Supplies | | | 3,000 | | |  |  |
| Capital | | | 0 | | |  |  |
| Travel | | | 4,000 | | |  |  |
| Overhead (ICRISAT 17%) | | | 3,910 | | |  |  |
|  | | | | |  | | | | **Total** | | | **26,910** | | |  |  |

13. Gantt Chart1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | |
| **Jul** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Literature review |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Refining of research tools |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Training of enumerators |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Geographic survey of technologies |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Socio Economic Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Quarterly report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Final Report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Draft of scientific publication |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 4: Effective partnerships to ensure delivery and large-scale uptake of SI technologies and practices are established with farmers, local communities, and research and development partners in the private and public sectors. | | | | | | | | | | | | | | | | |
| a. Output 4.4 | | | Knowledge sharing centers and learning alliances within existent local and regional institutions including development actors developed. | | | | | | | | | | | | | |
| b. Activity 4.4.1 | | | Establish knowledge-sharing and learning alliances among scaling actors. | | | | | | | | | | | | | |
| c. Sub-activity MA4411-19 | | | Manage the operations of four technology parks as hubs for research and demonstration in Bougouni and Koutiala. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | | | |
| Name | Institution | | | | Role | | | | | | | | | | | |
| Birhanu Zemadim | ICRISAT | | | | Leader | | | | | | | | | | | |
| Tumaini Sidibe | FENABE | | | | Bougouni site coordinator and facilitator of multi-stakeholder interest group meeting | | | | | | | | | | | |
| Mahamadou Dicko | AMEDD | | | | Koutiala site coordinator and facilitator of multi-stakeholder interest group meeting | | | | | | | | | | | |
| John Nzungize | ICRISAT | | | | Scaling best-bet technologies | | | | | | | | | | | |
| Karamoko Sanogo | ICRISAT | | | | Data manager | | | | | | | | | | | |
| Karamoko Traore | ICRISAT | | | | Agronomic training and field preparation | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | | | | | | | |
| Name | Institute | | | | | | Degree | | | Start | | | | | End | |
|  |  | | | | | |  | | |  | | | | |  | |
|  | | | | | | | | | | | | | | | | |
| f. Location(s) | Bougouni and Koutiala districts | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| g. Start | April 2017 | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| h. End | March 2021 | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 1. Justification: | | | | | | | | | | | | | | | | |
| The Mali Africa RISING project is coordinated by ICRISAT in close collaboration with partner institutes. Four technology parks were established, two in Bougouni (Flola and Diaba villages), and two in Koutiala (M’Pessoba and N’Golonianasso villages). These parks have been used by participating institutes (ICRISAT, ICRAF, WorldVeg, and IER) to conduct controlled research experiments. Training programs have been conducted in the parks for local NGOs, national training centers and communities living in Africa RISING intervention villages. The parks have been used by other programs like the West Africa sorghum improvement program, the sorghum and millet dissemination project (ARDT\_SMS), and the groundnut improvement program for capacity building and outreach activities. Also, the establishment of the parks has integrated research and capacity building activities by the different project partners, for example by the UNDP land management program and the AfDB funded TAAT program.  From phase I of the program, it was understood that the long-term sustainability of running innovation platforms was not very likely. In this case, the four technology parks have been utilized to conduct multi-stakeholder interest group meetings and this is to continue in the current year and beyond. Emphasis will be given to engaging more youth in research and scaling activities. The end goal is to formalize the four parks as unique community-level multi-stakeholder platforms for all programs conducted in the specific village. The social mobilization and activities in the parks will be guided by the local NGOs, AMEDD (in Koutiala) and FENABE (in Bougouni). | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | | |
| 2.1 Conducting integrated and multi-disciplinary research and scaling strategy on sustainable intensification program | | | | | | | | | | | | | | | | |
| 2.2 Developing a research hub for validating Africa RISING technologies for wider dissemination, providing capacity building and short-term training programs | | | | | | | | | | | | | | | | |
| 2.3 Provide a site for the multi-stakeholder interest group meeting | | | | | | | | | | | | | | | | |
| 2.4 Provide information concerning proven technological practices and climate services to farmers, local NGOs and extension agents | | | | | | | | | | | | | | | | |
| 2.5 Provide high-quality agricultural inputs (plant material, fertilizer etc.), and climate-smart water access facilities to farmers | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | | | |
| 3.1 How suitability are technology parks as a means of demonstration and experimentation? | | | | | | | | | | | | | | | | |
| 3.2 What are the mechanisms involved when working with development partners to ensure success and innovation? | | | | | | | | | | | | | | | | |
| 3.3 How can progress towards scaling be tracked and monitored and feedback received to inform the research components on what is working and what is not applicable? | | | | | | | | | | | | | | | | |
| 3.4 How can the partnership model on inclusive monitoring and evaluation conducted by scaling actors be implemented in other areas beyond Mali? | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | | | |
| The four technology parks will be utilized by the research team for various research and dissemination strategies. At each site, scientists and implementing partner institutes will identify and determine the size of the field plot to implement the field trials. Training programs will be provided to participating farmer groups (particularly the youth and women groups) on the introduced technology before activity implementation. With the use of these technology parks and independently identified farmers’ fields, and according to the phase II proposal we are expecting to reach 3,142 households through research and capacity building activities in the year 2019/2020.  Identified best-bet technologies will be scaled to approximately 14,690 households through development actors who are working with the Africa RISING program. The socio-economy group will monitor the adoption of identified technologies in farmers’ fields and conduct continuous monitoring and evaluation of the five sustainable intensification domains. In each technology park, a farmer field day will be organized to bring various groups of farmers (adult, youth, women etc.) together and create an opportunity to discuss the types of technologies introduced, the relevance and challenges among the farmer groups. Approximately 300 farmers are expected in each of the farmer field days and one-third of the invitee would be youth farmers. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded | | | | | | | | | | | | Responsibility/Institute | | | | |
| Is the collected data part of a multi-year experiment/trial? Yes | | | | | | | | | | | |  | | | | |
| 5.1 All field trial data that include agronomic, land, soil and water management | | | | | | | | | | | | ICRISAT | | | | |
| 5.2 All data related to training and farmers field visit | | | | | | | | | | | | ICRISAT | | | | |
|  | | | | | | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | | | | | | |
| Deliverables | | | | | | Means of verification | | | | | | | | Delivery date | | |
| 6.1 Biophysical database on improved technological practices and participatory research in the technology parks | | | | | | Implemented trials, metadata and database uploaded on Dataverse | | | | | | | | Jun. 2020 | | |
| 6.2 Types of technologies disseminated, capacity building, farmers’ field visit and video demonstration | | | | | | Interim and final reports to IITA | | | | | | | | Jun. 2020 | | |
|  | | | | | | | | | | | | | | | | |
| 7. Sustainable intensification indicators | | | | | | | | | | | | | | | | |
| Domain | | Indicator | | | | | | Metrics/Scale | | | | | | | | |
| 7.1 Productivity | | N/A | | | | | |  | | | | | | | | |
| 7.2 Environmental | | N/A | | | | | |  | | | | | | | | |
| 7.3 Economic | | N/A | | | | | |  | | | | | | | | |
| 7.4 Social | | Social cohesion  Collective action | | | | | | % of community members participating in some form of social group at landscape level  Participation in a collective action group at household level | | | | | | | | |
| 7.5 Human | | Capacity to experiment | | | | | | * Number of new practices being tested by type at farm level * Number of farmers experimenting * Number of men and women literate * Number of men and women with numeracy | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 8. How will scaling be achieved? | | | | | | | | | | | | | | | | |
| The technology parks are sites for technological innovation, demonstration and capacity building. Best-bet technological innovations will be scaled-up to farmers’ fields through farmers exchange visits and implementation of trials at farmers’ fields. Hence, technology parks are considered as ideal sites where scaling work starts. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 9. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | | | |
| The proposed crop-livestock activities in the current work plan were previously implemented in the technology parks and will be implemented in the same technology parks. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 10. Custom Indicators | | | | | | | | | | | | | | | | |
| * Number of trainings conducted * Number of farmers trained (gender-disaggregated) * Number and types of technologies implemented * Number of visits made by development institutions * Number of farmers, field extension agents, and service techniques and other actors visited the parks during farmer field days | | | | | | | | | | | | | | | | |
| 11. Impact based summary matrix | | | | | | | | | | | | | | | | |
| 11.1 What is the development challenge you are addressing?  In rural Mali, technology adoption is hampered by lack of reliable technological validation options that include but not limit to researcher-developed technologies, farmers’ awareness to the developed technologies, farmers’ technical skills in adopting developed technologies and social and behavioral links among researchers, farmers and extension agents. On-station developed technologies will be reaching the farmers through technology parks developed within the agro-ecologies of farmers’ settings. Technology parks are also equipped with training facilities to provide the required technological trainings. This approach is ideal to introduce farmers to the developed technology and sensitize them through awareness programs to support the adoption of technologies. | | | | | | | | | | | | | | | | |
| 11.2 Who is your target audience, e.g. extension agents, farmers, or policymakers?  The target audiences are farmers, extension agents, development projects working on resilience strategies. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| 12. Budget (US$) | | | | | | | | | | | | | | | | |
| Outcome/Output/Activity | | | | Sub-activity | | | | | **Budget line item** | | **ICRISAT** | | **AMEDD** | | | **FENABE** |
| Outcome 4/Output 4/Activity 1 | | | | MA4411-19 | | | | | Personnel | | 30,000 | | 2,500 | | | 2,500 |
| Services | | 5,500 | | 4,000 | | | 4,000 |
| Supplies | | 3,500 | | 1,000 | | | 1,000 |
| Capital | |  | |  | | |  |
| Travel | | 3,500 | | 2,500 | | | 2,500 |
| Overhead (17%) | | 7,225 | | 1,700 | | | 1,700 |
| **Total** | | **49,725** | | **11,700** | | | **11,700** |
| **Grand total** | | | | **73,125** | | | | | | | | | | | | |

13. Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year/ Month/ Week** | **2019** | | | | | | | | | | | | | | | | | | | | | | | | **2020** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **July** | | | | **Aug** | | | | **Sep** | | | | **Oct** | | | | **Nov** | | | | **Dec** | | | | **Jan** | | | | **Feb** | | | | **Mar** | | | | **Apr** | | | | **May** | | | | **Jun** | | | | **Jul** | | | |
| **Week** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Running integrated and multi-disciplinary research and scaling strategy |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Conducting multi-stakeholder interest group meeting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Organization of field day |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Farmers feedback session on technologies |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Consolidated budget

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sub-activity** | **leader** | **ICRISAT** | **ILRI** | **WorldVeg** | **IITA** | **IER** | **WUR** | **AMEDD** | **FENABE** | **Total** |
| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets | | | | | | | | | | |
| MA1111-19: Evaluating crop simulation models using different fertility sources and climate model outputs to improve the productivity of sorghum | ICRISAT | 56,160 |  |  |  |  |  | 9,360 |  | 65,520 |
| MA1112-19: Understanding soil fertility management in cereal cropping systems in southern Mali | ICRISAT | 45,630 |  |  |  |  |  |  |  | 45,630 |
| MA1113-19: Testing adaptation of dual purposes sorghum hybrids in Mali to diversify options for crop-livestock integration | ICRISAT | 64,350 |  |  |  |  |  |  |  | 64,350 |
| MA1114-19: Evaluating and disseminating promising technologies tested in 2018 performance and profitability to intensify vegetable production under rainfed and dry seasons | ICRISAT | 18,720 |  | 55,000 | 10,000 |  |  | 7,020 |  | 90,740 |
| MA1121-19: Efficient feed utilization through improved feed troughs | ILRI |  | 81,776 |  |  |  |  |  |  | 81,776 |
| MA1122-19: Fodder production for improved ruminant production | ILRI |  | 46,420 |  |  |  |  |  |  | 46,420 |
| MA1131-19: Risk management and informed decision-making towards sustainable intensification of crop-livestock systems | WUR |  |  |  |  |  | 27,741 |  |  | 27,741 |
| MA1211-19: Determination of cropping management factors using empirical relations, GIS, and Remote Sensing tools in two agroecologies in Mali | ICRISAT | 29,835 |  |  |  |  |  | 9,360 |  | 39,195 |
| MA1212-19: Improving crop-livestock productivity and household income through the use of contour bunding and agroforestry options | IER |  |  |  |  | 40,085 |  |  |  | 40,085 |
| MA1221-19: Improved irrigation technologies for efficient and sustainable agricultural water management in rural Mali | ICRISAT | 43,875 |  |  |  |  |  |  |  | 43,875 |
| ***Sub-total Outcome 1*** |  | *258,570* | *128,196* | *55,000* | *10,000* | *40,085* | *27,741* | *25,740* | *0* | *545,332* |
| Outcome 2: More farmers and farm families are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition | | | | | | | | | | |
| MA2221-19: More farmers and farm families are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition | WorldVeg |  |  | 13,000 |  |  |  |  |  | 13,000 |
| ***Sub-total Outcome 2*** |  | *0* | *0* | *13,000* | *0* | *0* | *0* | *0* | *0* | *13,000* |
| Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI, technologies, innovations and practices | | | | | | | | | | |
| MA4111-19: Determine farmers' preferences of technology attributes in cereal-legume systems of southern Mali | ICRISAT | 41,535 |  |  |  |  |  |  |  | 41,535 |
| MA4311-19: Evaluation of the effect of implemetatiom of communicaty local conventions for natural resource management in southern Mali | ILRI |  | 31,619 |  |  |  |  |  |  | 31,619 |
| MA4312-19: Assess the impat of Innovation Platforms on SI technology uptake in Africa RISING intervention communities | AMEDD |  |  |  |  |  |  | 39,195 |  | 39,195 |
| MA4313-19: GIS mapping of implemented technologies across different agro-ecologies and gender influence in technology adaptation and use in Bougouni and Koutiala districts of Mali | AMEDD |  |  |  |  |  |  | 26,910 |  | 26,910 |
| MA4411-19: Operation of four technology parks as hubs for research and dissemination in Bougouni and Koutiala | ICRISAT | 49,725 |  |  |  |  |  | 11,700 | 11,700 | 73,125 |
| ***Sub-total Outcome 4*** |  | *91,260* | *31,619* | *0* | *0* | *0* | *0* | *77,805* | *11,700* | *212,384* |
| Allocation for graduate study |  | 29,450 |  |  |  |  |  |  |  | 29,450 |
| **Grand total** |  | **379,280** | **159,815** | **68,000** | **10,000** | **40,085** | **27,741** | **103,545** | **11,700** | **800,166** |

# Feed the Future and Custom Indicators

|  |  |  |
| --- | --- | --- |
| **Indicator code** | **Feed the Future or Custom** | **FY 2017**  **Target** |
|  | |  |
| **4.5.2(42): (4.5.2-28)** | Number of for-profit private enterprises, producers’ organizations, water users’ associations, women’s groups, trade and business associations and community-based organizations (CBOs) that applied improved organization-level technologies or management practices with USG assistance |  |
|  | Type of organization |  |
|  | Private enterprises (for profit) |  |
|  | Producers organizations |  |
|  | Water users’ associations |  |
|  | Women's groups |  |
|  | Trade and business associations |  |
|  | Community-based organizations (CBOs) |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
| **4.5.2(2)** | Number of ha of land under improved technologies or management practices with USG assistance |  |
|  | Technology type |  |
|  | crop genetics (maize, p'pea, sorghum, bambara, g/nut, livestock forages) |  |
|  | pest management |  |
|  | disease management (MLN) |  |
|  | soil-related |  |
|  | irrigation |  |
|  | water management |  |
|  | climate mitigation or adaptation |  |
|  | other |  |
|  | total w/one or more improved technology |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Joint |  |
|  | Association-applied |  |
|  | Disaggregates Not Available |  |
| **EG.3.2-1: (4.5.2-7)** | Number of individuals who have received USG-supported short-term agricultural sector productivity or food security training |  |
|  | Type of individual |  |
|  | Producers |  |
|  | People in government |  |
|  | People in private sector firms |  |
|  | People in civil society |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Disaggregates Not Available |  |
| **4.5.2(11):** | Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance (RIA) (WOG) |  |
|  | Type of organization |  |
|  | Private enterprises (for profit) |  |
|  | Producers organizations |  |
|  | Water users associations |  |
|  | Women's groups |  |
|  | Trade and business associations |  |
|  | Community-based organizations (CBOs) |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
| **EG.3.2-17: (4.5.2-5)** | Number of farmers and others who have applied improved technologies or management practices with USG assistance |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Disaggregates Not Available |  |
| **4.5.2(12):** | Number of public-private partnerships formed as a result of FTF assistance |  |
|  | Agricultural production (NAFAKA) |  |
|  | Agricultural post harvest transformation |  |
|  | Nutrition (Tuboreshe Chakula?) |  |
|  | Multi-focus |  |
|  | Other |  |
|  | Disaggregates Not Available |  |
| **EG.3.2-x27: (4.5.2-27)** | Number of members of producer organizations and community-based organizations receiving USG assistance (S) |  |
|  | Type of organization |  |
|  | Producers’ organization |  |
|  | Non-producer-organization CBO |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Disaggregates Not Available |  |
| **(4.5.2(42): (4.5.2-28).** | Number of private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and CBOs that applied improved technologies or management practices as a result of USG assistance |  |
|  | Type of organization |  |
|  | Private enterprises (for profit) |  |
|  | Producers organizations |  |
|  | Water users associations |  |
|  | Women's groups |  |
|  | Trade and business associations |  |
|  | Community-based organizations (CBOs) |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
| **4.5.2(39):** | Number of technologies or management practices in one of the following phases of development: (Phase I/II/III) (S) |  |
|  | Phase 1 Number of new technologies or management practices under research as a result of USG assistance |  |
|  | Phase 2 Number of new technologies or management practices under field testing as a result of USG assistance |  |
|  | Phase 3 Number of new technologies or management practices made available for transfer as a result of USG assistance |  |
|  | Number of children under 2 (0-23 months) reached with community-level nutrition interventions through USG-supported programs |  |
|  | Male |  |
|  | Female |  |
|  | Number of individuals receiving nutrition-related professional training through USG-supported programs |  |
|  | Male |  |
|  | Female |  |
|  |  |  |
| **1** | Number of community-based, regional and national networks and partners established to exchange knowledge and information. |  |
| **2** | Number of on-farm demonstrations established |  |
| **3** | Number of field days organized |  |
| **4** | Number of youth and women participating in project activities |  |
| **5** | Youth |  |
| **6** | Women |  |
| **7** | Number of households using climate information or implementing risk-reducing actions to improve resilience to climate change |  |
| **8** | Number of guidelines and training materials developed by AR researchers? Maybe disaggregate by topic of training |  |
| **9** | Number of graduate (MSc and PhD) students trained as part of AR |  |
| **10** | PhD |  |
| **11** | New |  |
| **12** | Continuing |  |
| **13** | MSc |  |
| **14** | New |  |
| **15** | Continuing |  |
| **16** | Number of AR project reports produced |  |
| **17** | Number of AR-based journal papers published |  |
| **18** | Number of posters, policy briefs, leaflets and films produced by AR researchers |  |
| **19** | Number of radio and TV discussions organized by AR researchers |  |
| **20** | Number of households benefiting from nutrition intervention due to AR |  |
| **21** | Percent change in dietary diversity score of farm household in the project intervention communities. |  |
| **22** | Number of households, especially women with access to home or community garden due to AR |  |
| **23** | Number of women and youth participating in production and marketing decisions as a result of AR |  |
| **24** | Youth |  |
| **25** | Women |  |
| **26** | Percent aflatoxin reduction at harvest through use of Aflasafe in the field |  |
| **27** | Number of published guidelines on market opportunities and market niches |  |
| **28** | Number of community-based producers' organizations established and/or strengthened for production, processing and marketing. |  |
| **29** | Number of households clustered to viable value chains by type of market orientation |  |
| **30** | Number of agricultural and nutritional enabling policies, regulations and administrative procedures recommended and communicated by AR researchers |  |
| **31** | Number of knowledge sharing centers and learning-alliances developed AR researchers within existing local and regional institutions. |  |
| **32** | Number of people trained in CSA including PICSA approach. |  |
| **33** | Number of farmers using climate information in their decision-making |  |

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